DEPARTMENT OF THE ARMY TECHNICAL MANUAL TM11-2215

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER TO.16-35TT5-6

TELETYPEWRITERS TT-5/FG AND TT-6/FG

DEPARTMENT OF THE ARMY • JUNE 1951

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TM 11-2234, TM 11-2215, TM 11-2216, TM 11-2222, TM 11-352, TM 11-358

Subject of investigation	Corrective action to date
TELETYPEWRITERS. Rapid failure of electrical contact brushes.	This difficulty is attributed to the occasional mismatching of brush and commutator materials. To facilitate prompt replacement of worn brushes, the applicable SIG 7&8 supply manuals are being revised to provide for the issuance of a set of brushes as running spares.

NOTE: The above information obtained from TB SIG 213-11, Digest of Field Reports for Signal Corps Equipment, dated 16 May 1956.

TM 11-2215—To. 16-35TT5-6

This manual supersedes TM 11-2215, 25 November 1944

TELETYPEWRITERS TT-5/FG AND TT-6/FG

United States Government Printing Office

Washington : 1951

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *14 June 1951*

TM 11-2215 is published for the information and guidance of all concerned.
[AG 413.48 (23 Mar 51)]

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CONTENTS

Figure 1. Teletypewriter TT–5/FG (or TT–6/FG) in position for operation.

This manual supersedes TM 11-2215, 25 November 1944

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information covering the installation, operation, maintenance, and repair of Teletypewriters TT-5/FG and TT-6/FG (fig. 1).

b. This manual is prepared in five chapters and four appendixes. The first appendix contains a list of pertinent references and the second appendix contains an identification table of parts. The third appendix includes instructions regarding the interoperation of British and American teletypewriters, and the fourth appendix is a glossary.

2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

a. DD Form 6 will be filled out and forwarded as prescribed in SR 745-45-5 (Army) and AFR 71-4 (Air Force).

b. DA AGO Form 468 will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700-45-5.

c. AF Form 54 will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

d. DA AGO Form 419 will be prepared in accordance with instructions on the back of the form.

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. General

a. Teletypewriters TT-5/FG and TT-6/FG are Teletype model 15 page printing sets (fig. 1) used as fixed station communication equipment. In this capacity they exchange typewritten page messages between two or more distant points. One set of either type completely equips a station for sending to and receiving from one or more distant stations connected by a telegraph channel. These sets are arranged for direct transmission by the keyboard which is connected in series with the local teletypewriter relay and the line in such a manner as to actuate the local and distant receiving components, thereby furnishing a home copy of both transmitted and received messages at each station. The table is designed to support and cushion the teletypewriter unit and all other components.

b. Teletypewriter TT-5/FG is used for general communication purposes. Teletypewriter TT-6/FG is particularly adapted to the reception, and dissemination of weather information.

Note. Except where otherwise stated, information given in the text will be considered applicable to both teletypewriters. Refer to paragraph 7 for differences between the two teletypewriters. Both the transmitted and received messages at each station are recorded on a continuous roll of paper $8\frac{1}{2}$ inches wide.

c. An assembled teletypewriter set occupies a space approximately $21\frac{5}{16}$ inches deep (front to rear), 18 inches wide, and $42\frac{1}{8}$ inches high and has an over-all weight of approximately 200 pounds. Model 15 teletypewriters normally are adjusted for a standard American speed of 368.1 opm (operations per minute) which permits sending and receiving approximately 61 wpm (words per minute). By varying the speed with adjustment of the motor governor, it is possible to increase this speed to 404 opm or 67 wpm when interoperation with equipment operating at a higher speed (such as British teleprinters) is desired.

Refer to paragraphs 22 and 208 and appendix III for speed adjustments.

d. While it may be necessary and even advantageous under certain conditions to operate without a rectifier or table, a rectifier is included as a part of each of these teletypewriters to facilitate operation over greater distances or less desirable circuits and to improve performance and flexibility. For example, a model 15 teletypewriter with a rectifier may be used to communicate with another model 15 teletypewriter that has no rectifier unless the length or resistance of the line is great enough to require that battery be supplied, in series, from both ends of the line. The signal line current applied to the equipment (through line winding and transmitter contacts) is approximately .060 ampere.

4. Component Parts and Packing Data

a. Table of Components. The principal components of Teletypewriters TT–5/FG and TT–6/FG are the same except that Teletypewriter TT–5/FG has a standard communication keyboard and corresponding type pallets, whereas Teletypewriter TT–6/FG has a weather communication keyboard and corresponding type pallets. The principal components and units, with their Signal Corps stock numbers, are listed in the table below. These two teletypewriters have a black wrinkle finish and appear the same outwardly.

b. Packing Data for Export Shipment. Four boxes are required to package each teletypewriter set for export shipment. The typing unit is packed in one box, the base and table in another, the rectifier and keyboard in a third box, and the cover, motor unit, gear set, speed indicator (tuning fork), electrical service assembly for the table, relay, fuses, ribbon, copyholder, and technical manuals are packed in the fourth box. The cartons of equipment subject to damage from moisture (in this case all except the table minus its electrical service assembly, the cover, and small parts) are inclosed and sealed in waterproof metal containers, into which are placed bags of silica gel (desiccant) as protection against moisture and consequent rusting. The contents of the other cartons (table, cover, and parts) are protected by a moisture-vapor proof barrier. All components are cushioned with flexible corrugated fiberboard pads, then sealed in fiberboard cartons with gummed tape or other suitable material. Each component is blocked and braced with wood and/or corrugated fiberboard. The small parts are boxed individually in laminated or pressed paperboard boxes, then placed together

Quantity per set	Type of teletypewriter and Signal Corps stock No.		Component
	TT–5/FG (4T2.18A)	TT–6/FG (4T2.16A–1)	
1	4TBP22/210	4TBP93/221G	Typing unit.
1	4TBB44	4TBB44	Base (with filters).
1	4TXRT200AA	4TXRT200AA	Table.
1	4TREC29G	4TREC29G	Rectifier power unit.
1	4TBK22JX	4TBK22KQ/G	Keyboard (with filters).
1	4TBPC200AA	4TBPC200AA	Cover.
1	4TMU27G	4TMU27G	Motor unit (with filter).
1	4T80374	4T80374	Gear set (for 61 wpm at 368 opm).
1	4T103628	4T103628	Speed indicator (87.6 vps tuning fork).
1	4T105014G	4T105014G	Electrical service assembly.
1	4T115700AA	4T115700AA	Copyholder.
1	4TRY30G	4TRY30G	Relay (WECo type 255–A).
1	4T115706AA	4T115706AA	Cover, front plate.
2	4T74557	4T74557	Lamp.
2	4T7835	4T7835	Ribbon.
5	4T103284	4T103284	Fusetron (3.2 amp).
5	4T103286	4T103286	Fusetron (1.6 amp).
5	4T101063	4T101063	Fusetron (3.2 amp).
5	4T102701	4T102701	Fusetron (0.3 amp).

Note. These lists are for general information only. See appropriate publications for information pertaining to requisition of parts. Stock numbers are included in this table for identification purposes only. Refer to *b* below for packing information.

in a carton which is covered and sealed with a moisture-vaporproof barrier. Listed below are the weights, dimensions, and contents of each export package.

Teletypewriter parts and packing information (all dimensions and weights approximate)

Box No.	Component parts of Teletypewriters TT–5/FG or TT–6/FG	Dimensions (in.)			Domestic or preexport cartons (packed)			Dimensions and approx average gross weight packed for export
		Length carton	Width carton	Height carton	Net weight (lb)	Gross weight (lb)	Volume (cu ft)	Length—width—height
1	Typing unit	25	25	23	29	55	8. 3	159 lb 30½ x 28 x 30½ in. 15 cu ft
2	Base	19	19	11	23	27	2. 3	233 lb 50¼ x 27 x 31¼ in. 24.6 cu ft
	Table	24	21	28	39	48	8. 2	
3	Rectifier power unit	15	11	11	39	45	1	173 lb 45½ x 21½ x 18½ in. 10.5 cu ft
	Keyboard	16	14	8	9	13	1	
4	Cover	18	18	18	25	30	3. 4	181 lb 38¼ x 21¼ x 31¼ in. 14.6 cu ft
	Motor unit (with filter)	11	9	10	15	18	. 6	
	Gear set (for 368.1 opm)				1			
	Speed indicator (87.6 vps)				1			
	Electrical service assembly				6	7		
	Copyholder				1½	2		
	Relay (WECo type 255–A)				1	1½		
	Cover front plate				1½	2		
	Lamp							
	Ribbon							
	Fusetron (3.2 amp).							
	Fusetron (1.6 amp).							
	Fusetron (3.2 amp).							
	Fusetron (0.3 amp).							

Note. This list is for general information only. See appropriate publications for information pertaining to requisition of parts.

c. Packing Data for Domestic Shipments. Except for the elimination of the metal and moisture-vaporproof barriers, packaging for domestic shipment is generally the same as that for export shipping. Shipment may be received in shipping containers similar to those described in *b* above, with the following changes, depending upon the amount of handling anticipated and the length of storage contemplated.

(1) The use of a dehydrating agent, or desiccant, and a moisture-vaporproof barrier may be omitted.

(2) The use of excelsior cushioning and the outer shipping container may be omitted.

5. Characteristics

a. General. Teletypewriters TT–5/FG and TT–6/FG are motor-driven machines designed to interchange typewritten messages, by electrical means, between two or more points. The sending-receiving teletypewriter includes a keyboard transmitting unit, a typing unit, a motor unit, and a base unit. The base unit supports the other three units (keyboard, typing unit, and motor unit, figs. 4 and 6).

b. Receiving. The transmitting mechanism on the keyboard is driven through a set of gears by the main shaft of the typing unit. The keyboard may be removed and the set may be operated as receive-only equipment if desired. The wiring may be adapted (figs. 155 and 282) to receive either neutral or polar signals by merely pulling or pushing the polar-neutral key on the teletypewriter keyboard (figs. 4 and 7).

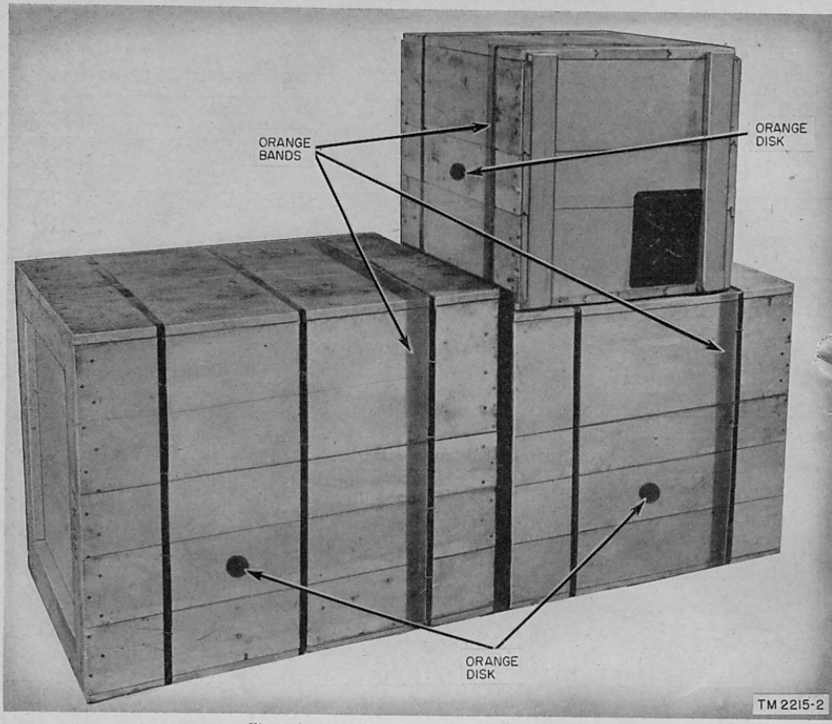


Figure 2. Typical packaging for export shipment.

c. Transmitting. To retain at least one copy of all transmitted messages at each station, the transmitting unit normally should be wired in series with the line winding of the polar relay which operates the typing unit. This permits sending and receiving with one teletypewriter on a single loop (one way at a time) basis. If simultaneous sending and receiving (double loop operation) is desired, a second receive-only teletypewriter should be used on the receive side of the double loop line to record the received messages. For transmitting other than neutral signals a terminal repeater or similar equipment must be used.

d. Control. All teletypewriters, except weather report teletypewriters, connected on the same circuit may be started through use of the mechanical motor control by momentarily opening the signal line (depressing the SEND REC BREAK key) and may be stopped by transmitting the upper case H signal combination from the keyboard of any teletypewriter in the circuit.

e. Operating Features. The TT–5/FG and TT–6/FG sets have friction paper feed, 110-volt, 50/60-cycle a-c (alternating-current) series-governed motors, a remote control motor stop mechanism (on the TT–5/FG only) operated by the upper case H key, and general purpose Rec-29 rectifiers, for local and/or line current, with built-in transformers for 95/125- and 190/250-

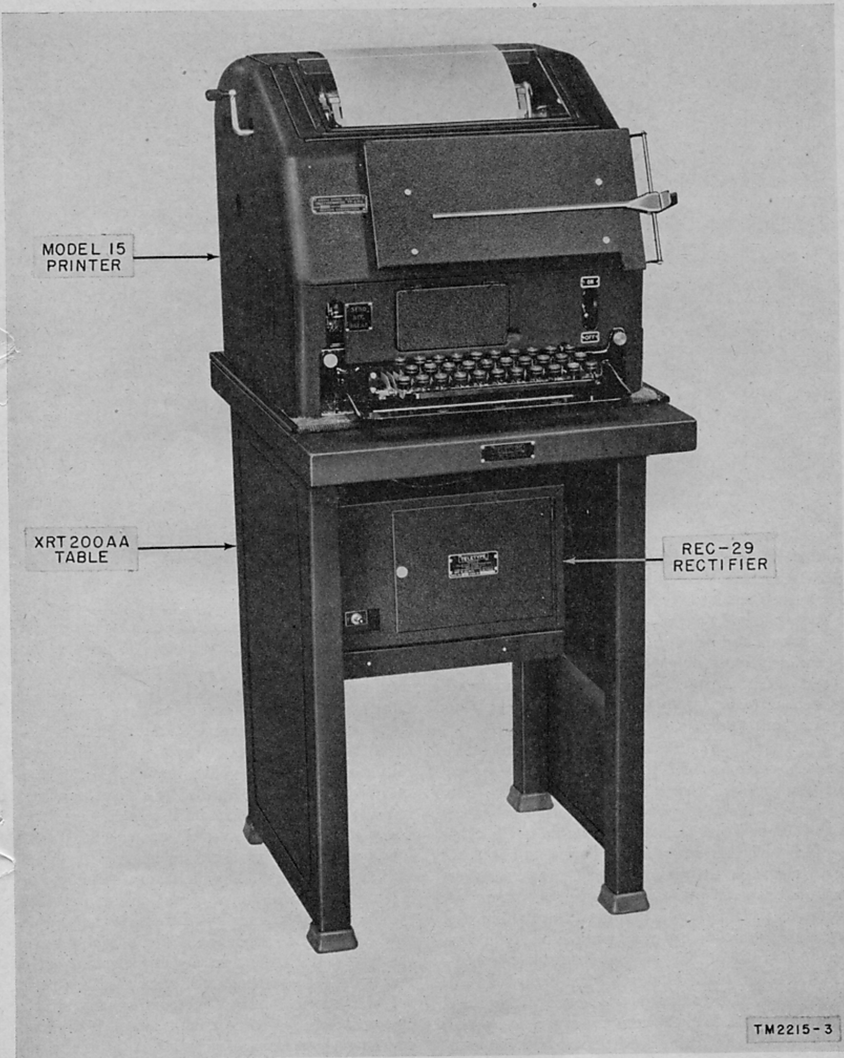


Figure 3. Complete teletypewriter set.

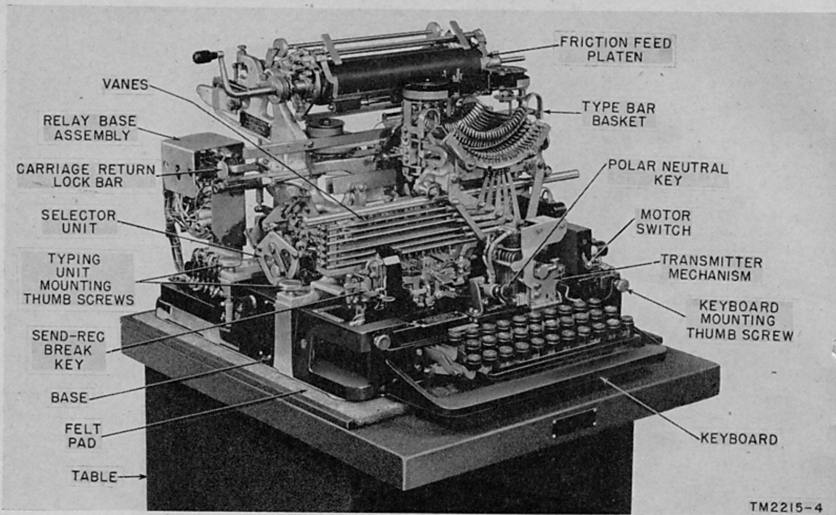


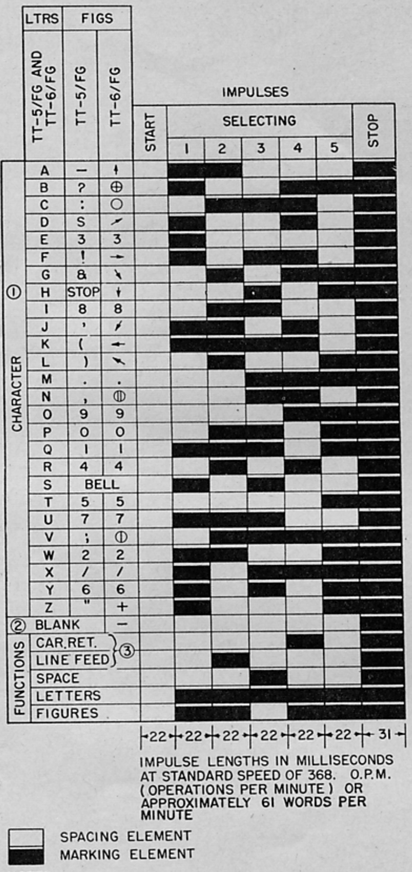
Figure 4. Typing unit assembled with base and keyboard.

volt, 25/60-cycle input. The transformer of the Rec-29 rectifier includes variable tap windings for adjusting motor terminal voltage. Signaling is accomplished through the use of a five-unit code of marking and spacing (current and no current) signal elements which are produced by mechanical action of the transmitting unit and are reconverted to mechanical action by the selector magnet of the typing unit (par. 9).

f. Utilization. To establish communication between stations some equipment is necessary to maintain and control a d-c (direct-current) line or loop to the teletypewriters. Such equipment may include series resistance installed in the teletypewriter or external to it, line units, d-c repeaters, telegraph switchboards, telegraph carrier terminals, speech-plus-duplex terminals or similar equipment, preferably capable of furnishing d-c through a variable resistance and maintaining correct bias (ratio of marking current to spacing current). When bias is not correct a signal is said to be distorted or to have marking or spacing bias. For very short loops, where there are no appreciable variations in line condition, it is possible to interconnect these teletypewriters directly over a pair of wires or one wire and ground if the correct d-c voltage is furnished in series through a resistance.

g. Synchronization (Timing). Maintenance of correct timing between transmitting and receiving units is achieved by means of the five-unit start-stop code. Five elements or impulses (seven with start and stop included) are fed into the line circuit of the teletypewriter for every operation to be performed by the receiving unit. Each of these five elements (impulses or intervals) is 22 milliseconds long. The first impulse of every five-impulse sequence is *preceded* by a start (spacing) impulse which is also 22 milliseconds long. The last element of the five-element sequence is *followed* by a stop (marking) element which is 31 milliseconds long. Thus the transmitting and receiving equipments on a signal circuit will both come to a stop at some point between the completion of one code sequence and the beginning of the next. With the next spacing element or interval these equipments will start their sequence, for all practical purposes, together and, if the motor speeds are correct, will complete their sequence without losing synchronism. Bias and distortion that may exist in a signal and corrective action are discussed in paragraphs 24, 81, and 285

of this manual and in TM 11–486 and TM–11–680. Figure 5 shows the code used and the duration of signal impulses referred to above.



NOTES:

① FIGS. H FOR MOTOR STOP ON TT–5/FG ONLY

② THE BLANK COMBINATION OPERATES FROM LTRS. POSITION ONLY, ON TT–6/FG

③ THESE FUNCTIONS PERFORMED FROM LTRS. POSITION ONLY, ON TT–6/FG

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Figure 5. Five-unit start-stop teletypewriter code.

6. Detailed Description of Teletypewriters TT–5/FG or TT–6/FG
(fig. 3)

a. Base. The base consists of a metal casting (fig. 6) set on top of the table and provides mounting facilities for the polar line relay (fig. 11), the motor unit (fig. 12), typing unit (fig. 13), and keyboard unit (fig. 10). Three bakelite terminal boards (fig. 6) are provided by which power is connected to the motor unit and signal lines are brought to the relay line winding and transmitter contacts. Two power cords (a-c and d-c) and two line cords (sending and receiving) are attached to the right side at the terminal boards. The sending cord terminates in a black-shell plug and the receiving cord terminates in a red-shell plug. The a-c power cord is provided with a two-prong plug and the d-c power cord is provided with a four-prong plug. The base unit is set and centered on a felt pad which is held in place on top of the equipment table by metal channels on both sides and at the rear of the table top. The line-relay mounting brackets and resistor assembly with wiring and motor control relay are mounted on the base toward the rear. The SEND REC BREAK key is a double-lever type key and is mounted on the front of the base to the left (fig. 6) and extends through an opening in the cover. The ON-OFF switch on the front of the base to the right serves to start and stop the motor manually. It is reached through an opening in the cover. The terminal boards for connecting a-c and d-c power and the signal line are mounted on the right side as viewed from the front. The terminal board for the line-relay connections is mounted on the left side toward the back. The line shorting jack and slip connections for the motor, keyboard, and typing unit are mounted on the base. R-f (radio-frequency) induction filters are mounted near the relay and power terminal boards.

b. Keyboard. The keyboard (fig. 10) contains the keys that must be operated to transmit a letter, figure, symbol, or a nonprinting function. Figures 8 and 9 show the keyboard and figure 61 indicates the function keys. The uses of the function keys are discussed in paragraph 26*b*. The keyboard is designed to slide into the front of the base where it is held in place by two knurled captive screws (one on each side). To remove it, loosen the knurled screws and pull the keyboard

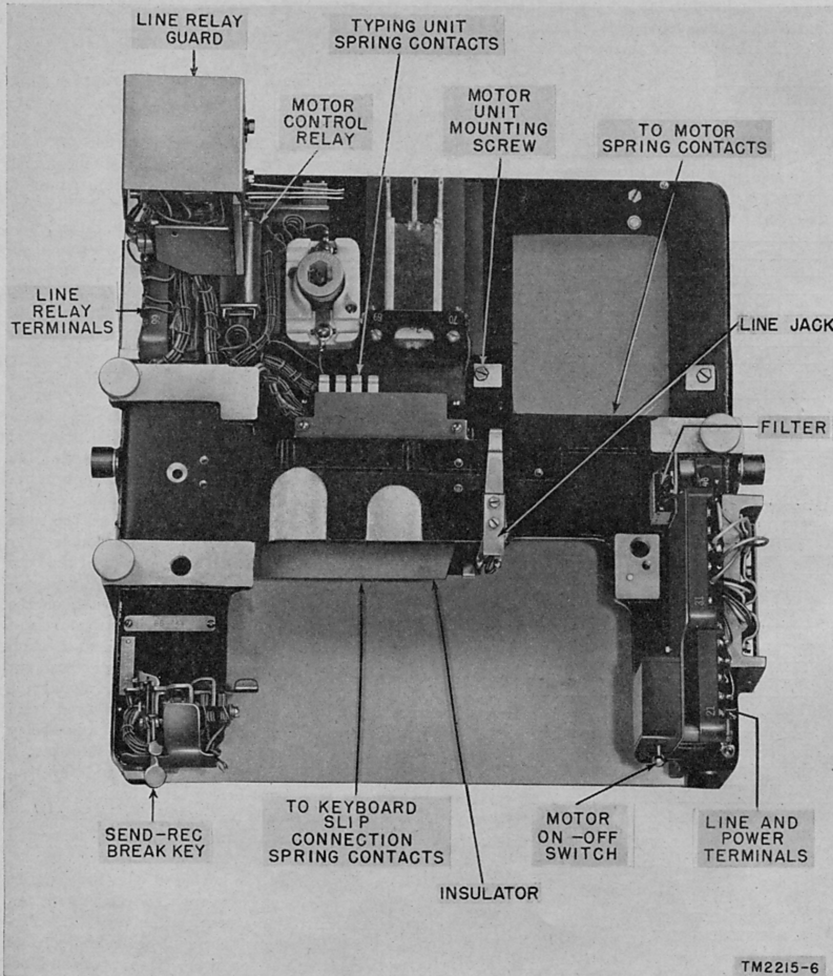

Figure 6. Teletypewriter base less motor unit.

out. The keyboard consists essentially of key-levers, space bar, slip-connection spring contacts for making electrical connection to the base, a polar-neutral key to select either polar or neutral operation for the receive circuit, and a keyboard transmitting unit with transmitting contact filter,

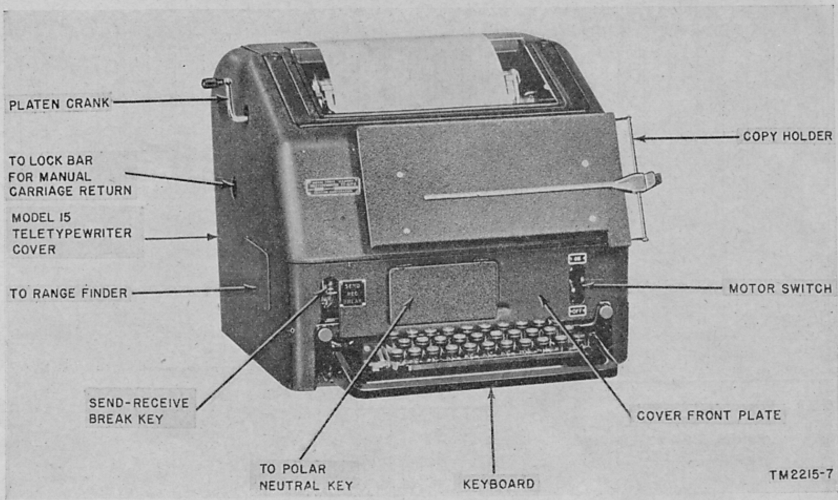

Figure 7. Teletypewriter less table and rectifier.

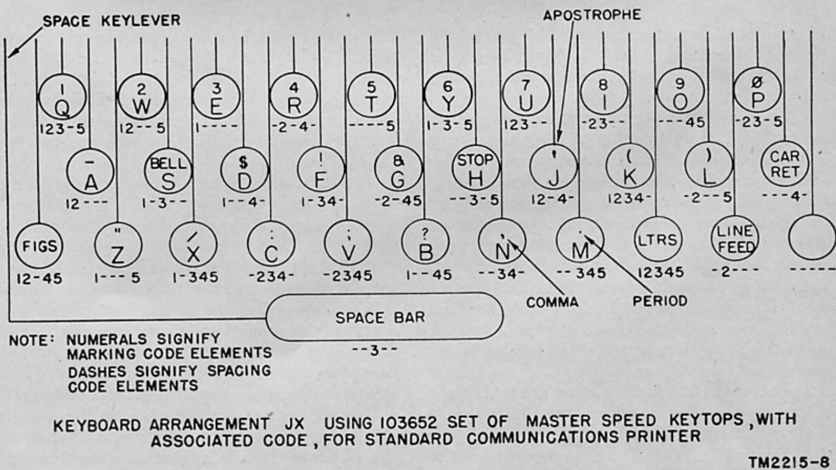

Figure 8. Standard communications keyboard and associated five-unit code for each character.

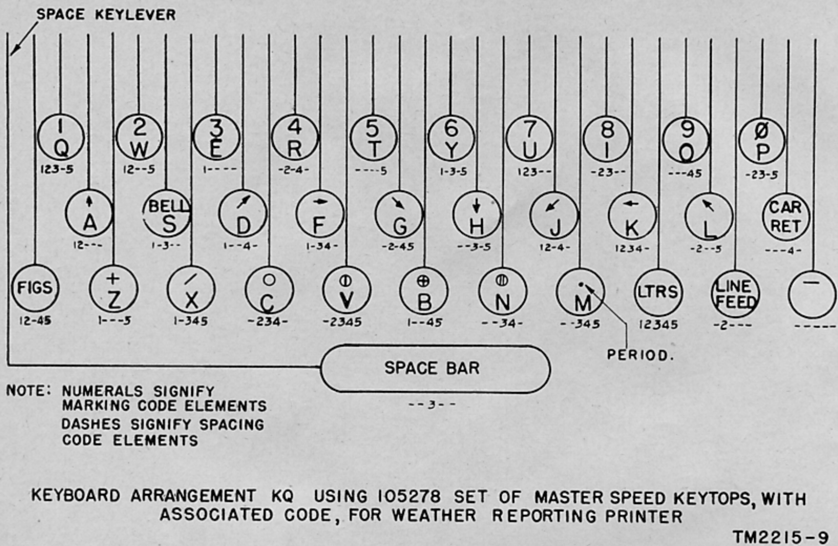

Figure 9. Weather communications keyboard and associated five-unit code for each character.

all fitted on a cast metal frame. The gear of the keyboard transmitting shaft is driven by a gear on the main shaft of the typing unit which in turn is driven by the motor.

c. TRANSMITTER. The transmitter, mounted on the keyboard, is an assembly of cams and spring contacts that open or close in accordance with the code for the character or function that is being transmitted. The key levers control operation of the transmitting contacts through code selector bars at the bottom of the keyboard, locking levers, contact levers, clutch, and associated mechanism. The rotating cams of the transmitter shaft operate the spring contact levers. Locking levers hold the contact levers in the open position when a spacing interval is being transmitted. The locking levers are released (or held inoperative) when a marking impulse is sent. The locking levers are held either in the open or the closed position during each shaft revolution by a lock loop bar.

d. RELAY (fig. 11). The line relay with which these teletypewriters are equipped is a WECo type 255–A relay. The relay connections can be changed to receive either neutral or polar type signals by operating the polar-neutral key (fig. 10).

(1) *Neutral.* To receive neutral signals the relay bias winding is connected into a d-c circuit by pulling the polar-neutral key *out.*

(2) *Polar.* To receive polar type signals the circuit is opened through the relay bias winding by pushing the polar-neutral key *in.*

e. MOTOR UNIT. The motor unit (fig. 12) consists of a series-governed motor mounted upon a base plate. The base plate of the motor unit contains the mounting screws by which it is mounted on the base of the teletypewriter. The base plate also has two screws for vertical adjustment to aline the motor pinion with the main shaft gear of the typing unit. Horizontal alinement is obtained by elongated screw holes in the base of the motor casting. Mounted near the flywheel-governor assembly of the motor unit is a lamp, lamp bracket, and lamp switch. The lamp is used

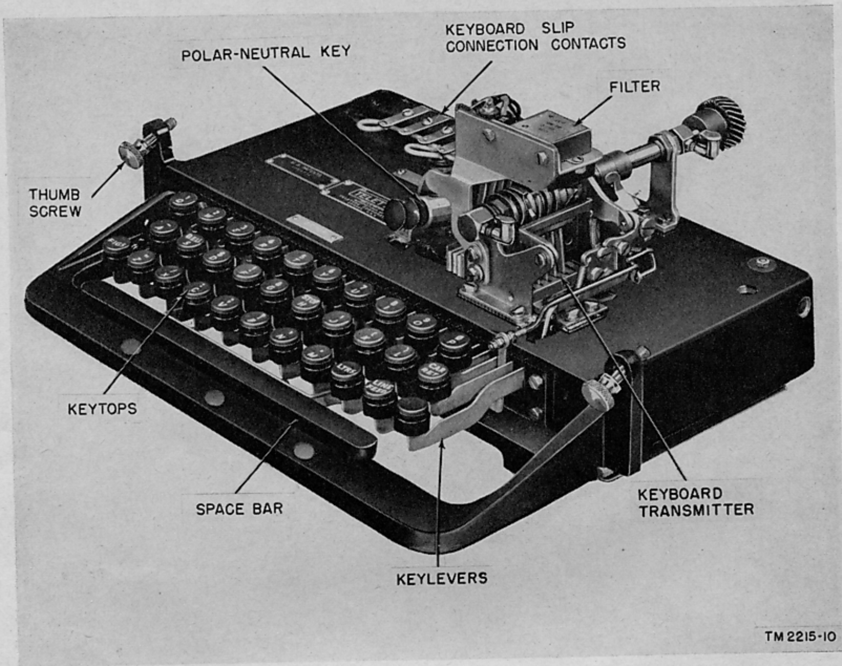

Figure 10. Teletypewriter keyboard unit.

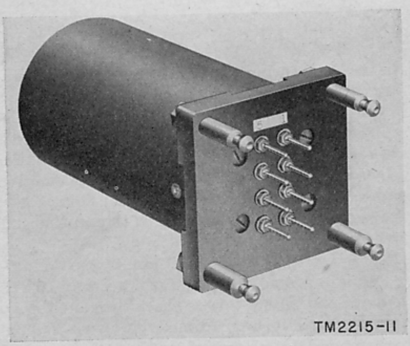

Figure 11. Polar line relay Ry-30 (WECo type 255-A).

to illuminate the target while the motor speed is checked with a speed indicator (fig. 18). The target consists of a series of alternate black and white segments painted on a rim that revolves with the motor governor flywheel. Circuit connections are established through spring contacts on the base unit. These contacts exert pressure against the terminals of the motor unit which is in position on the base unit. This motor unit is mounted at the right rear of the teletypewriter base and includes a filter for supressing r-f induction. Where regulated 50- or 60-cycle current is always available the correct one-speed synchronous motor may be used in place of the governed motor. Unless otherwise specified, the standard motor for Teletypewriters TT-5/FG and TT-6/FG is the M-27, a 110-volt, 50/60-cycle a-c series-governed motor.

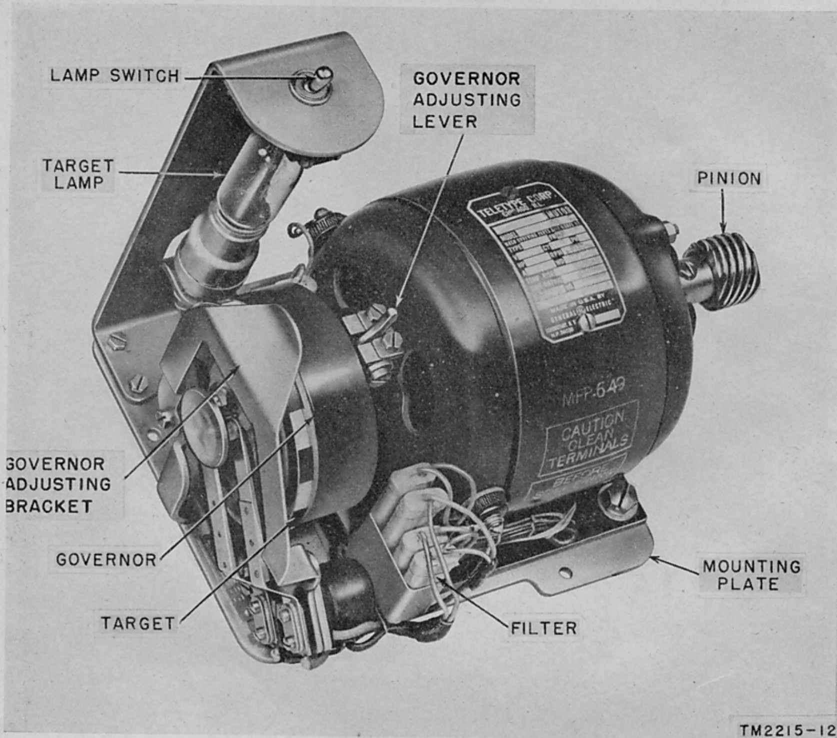

Figure 12. Motor unit M–27.

The motor unit may be removed from the base unit by removing three screws that hold the motor base plate to the base unit and lifting the motor upward.

f. Typing Unit. The typing unit is shown in figures 13 (front), 14 (back), 15 (bottom), 16 (left side), and 17 (right side). This unit consists essentially of selecting, printing, and functional mechanisms. The typing unit is mounted on the teletypewriter base and is held in place by three large thumbscrews.

g. Cover. A removable metal cover incloses the motor unit, typing unit, and base. The cover is constructed to allow easy access to the switches, paper, and units of the teletypewriter which must be reached during normal operation. Felt padding which lines the inside of the cover reduces sound and protects the operating parts of the teletypewriter. A copyholder is attached to the front of the cover (fig. 7). There are openings in the cover for the platen crank, checking orientation range, manual carriage return, polar-neutral key, paper outlet, and through which to pass line and power wiring.

h. Speed Indicator. The standard speed indicator is a tuning fork that vibrates at 87.6 vps (vibrations per second) to check the motor speed for 368.1 opm or approximately 61 wpm (words per minute). A slotted plate (fig. 18) is attached to the vibrating end of each tine of the fork. The

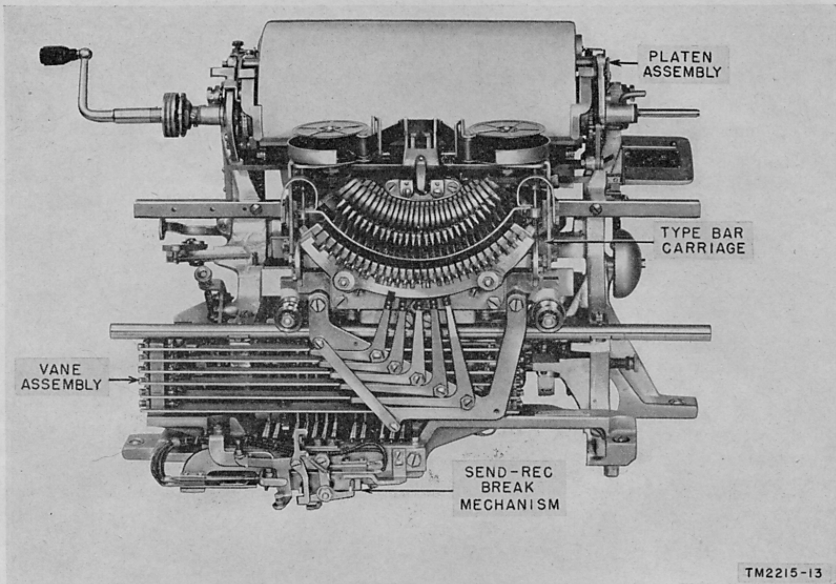

Figure 13. Front of typing unit.

rotating target of the motor unit is viewed through the aperture formed by the slots in these plates when motor speed is checked and adjusted. A special tuning fork that vibrates at 96.1 vps is required for 404-opm or 67-wpm operation.

i. RECTIFIER POWER UNIT. The series-governed motor operates on 50/60-cycle current at 110/120 volts. The local and signal line circuits require a d-c supply at 110/120 volts. These requirements are supplied by the Rec-29 rectifier unit that is part of each teletypewriter set. The rectifier supplied with some older models is the Rec-10 which differs little from Rec-29 (figs. 19 and 20).

(1) *Rectifier Rec-29.* This unit can be adjusted to work on a-c power supplies from 95 to 250 volts and from 25 to 60 cycles. It will deliver adjusted 110-volt a-c energy sufficient for the operation of two series-governed motors of the type used in these teletypewriters. It will also deliver 200 ma (milliamperes) of d-c at 120 volts for line and signaling circuits.

(*a*) *Components.* This rectifier consists essentially of a transformer, a full-wave selenium rectifying assembly (stack), a choke coil with tuning capacitor, a bleeder resistor, a filter capacitor, terminal panels, input and output fuses, an input power switch, an input cord with a plug, and two output cords with receptacles. The parts are secured to a metal base which is provided with feet. The metal cover has expanded metal panels for ventilation, and a hinged door provides access to the control panel and fuses.

(*b*) *Input.* The primary winding of the transformer has two sets of taps. One set provides for input voltages of 95 to 250 volts and terminates on the left-hand side of the control panel. The other set of primary taps provides the proper voltage for motor operation on 25-, 40-, 50-, or 60-cycle a-c.

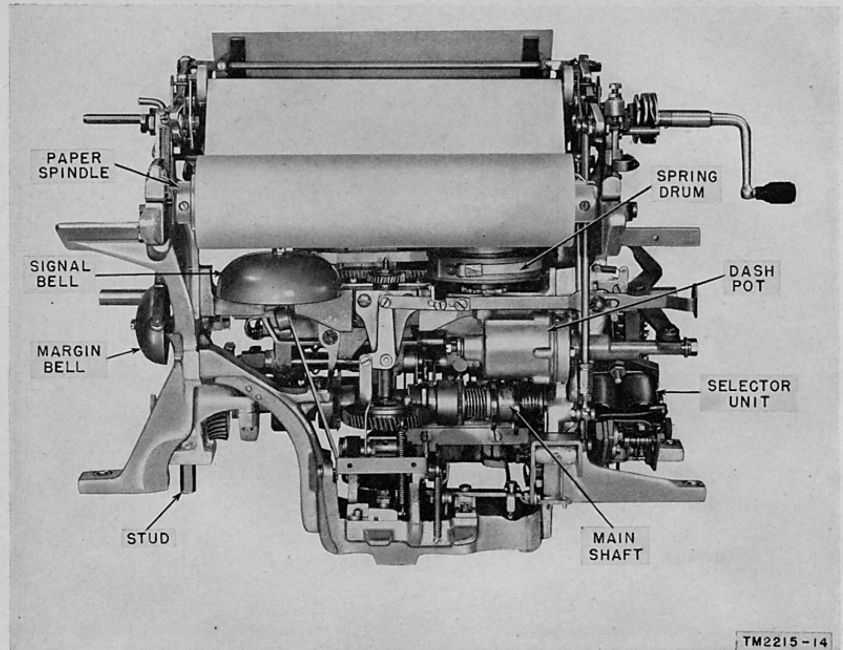

Figure 14. Back of typing unit.

(*c*) *Output.* The secondary of the transformer is provided with taps so that the output voltage of the rectifier can be adjusted to suit requirements and to compensate for aging of the rectifier assembly.

(*d*) *Filter.* The choke coil has taps which terminate on the upper right-hand corner of the control panel. These are provided to adapt the filter to the frequency of the power supply.

(*e*) *Cord panel and switch.* The input and output cords terminate on a panel at the rear of the rectifier. The double-pole switch is connected in the circuit, between the cord panel and the other parts of the rectifier unit, and disconnects both sides of the input line from the rectifier.

(2) *Rectifier Rec-10* (fig. 20). This unit differs from the Rec-29 unit in that it operates on 105 to 125 volts at 50 or 60 cycles only and does not supply motor voltage. Output d-c power and adjustments are similar to those of the Rec-29.

j. EQUIPMENT TABLE (fig. 21). The table is specially designed to support the teletypewriter and rectifier and to accommodate the associated cords and cables. The teletypewriter unit is set squarely on a pad which is held in place by channels on top of the table. A shelf built into the front of the table provides mounting space for the rectifier while allowing the operator sufficient leg room. An electrical service assembly mounted on the inside of the table provides terminals for line and

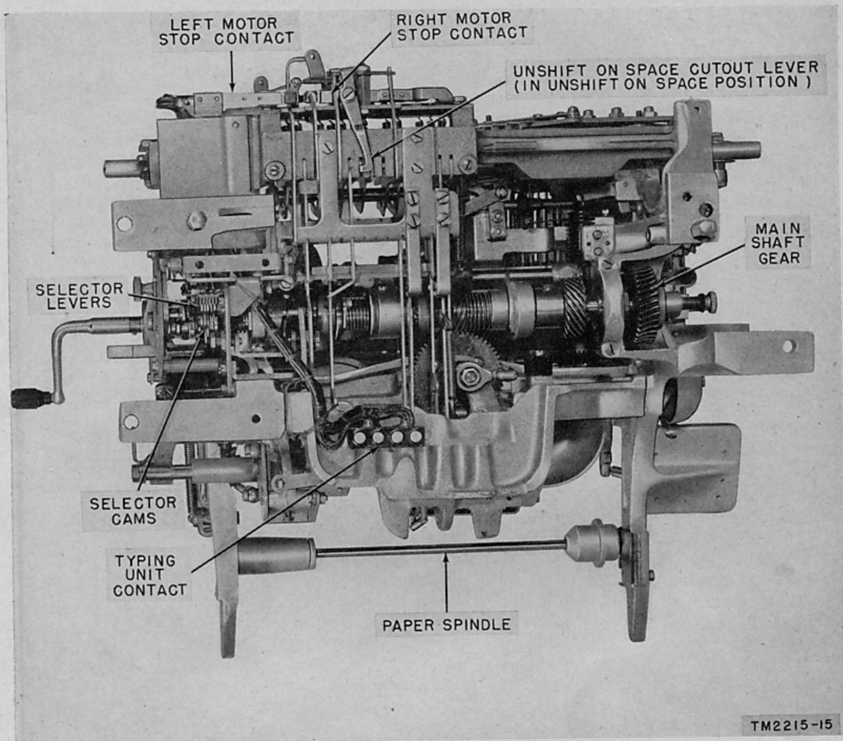

Figure 15. Bottom of typing unit.

battery, and plugs and receptacles for teletypewriter and rectifier. The table is equipped with rubber feet which, with a felt pad, promotes quietness of operation and cushions the teletypewriter.

k. ELECTRICAL SERVICE ASSEMBLY (fig. 53). This unit is bolted to the inner rear wall of the table, just under the table top facing the front. It provides a dummy test circuit for local tests and serves as a distribution panel to and from the rectifier, teletypewriter, and signal line. The a-c power source and the line are connected to terminals in the service assembly. The teletypewriter and rectifier are connected by plugs, receptacles, and jacks to the service assembly.

7. Differences Between Teletypewriters TT–5/FG and TT–6/FG

a. Teletypewriter TT–5/FG has a standard communications type of keyboard and type pallets (fig. 8). The right margin adjusting screws of the typing unit are adjusted to print the usual 72 characters per line. The typing unit suppresses printing and spacing for both the upper and lower case blank combinations. The line feed and carriage return functions are effective in either upper or lower case position. The motor may be stopped and started by remote control (from local or distant station keyboards).

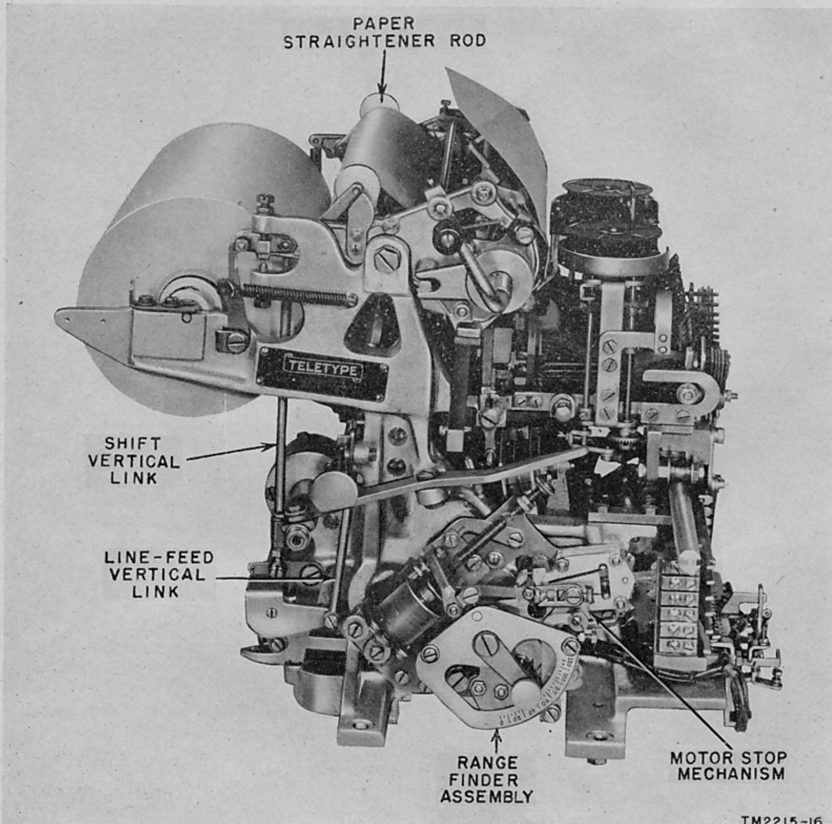

Figure 16. Left side of typing unit.

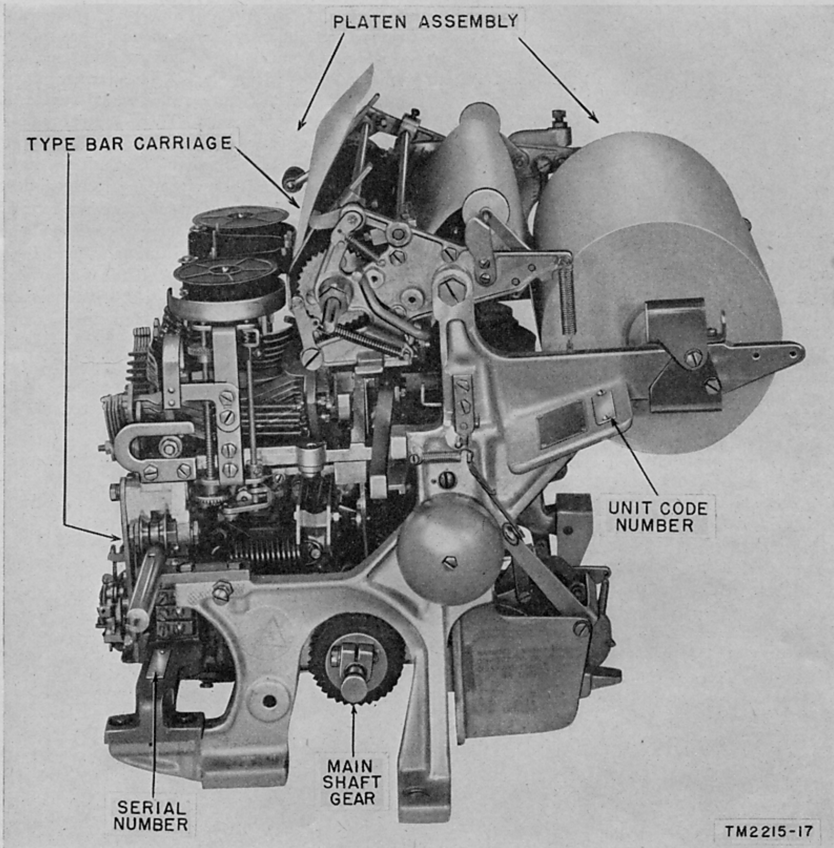

Figure 17. Right side of typing unit.

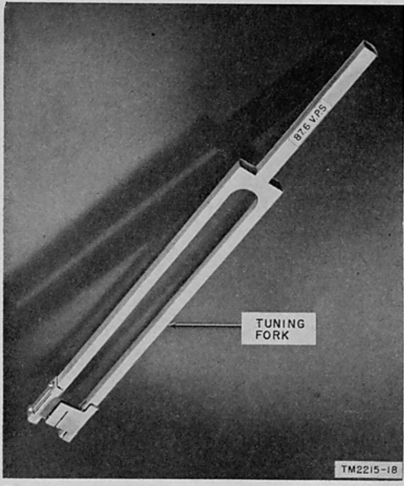

Figure 18. Speed indicator (tuning fork) for standard speed of 368.1 opm (operations per minute).

b. Teletypewriter TT-6/FG has a set of type pallets utilizing weather report symbols and a standard keyboard with weather report key markings to correspond (fig. 9). The margin adjusting screws of the typing unit are adjusted to print 76 characters per line. The teletypewriter is arranged to print and space on the upper case blank combination and suppress printing and spacing only on the lower case blank. The carriage return and line feed functions are effective in lower case (or letters) position only. The feature of remote motor control is not applicable to weather report teletypewriters, as all upper case positions have been assigned to necessary weather report symbols and figures. The special spacing, carriage return, and line feed functions of the weather report teletypewriter are accomplished through use of a set of parts containing three special function levers. Otherwise, the two types of teletypewriters are identical in component parts, functioning, and appearance.

c. Some older Teletypewriters TT-5/FG or domestic sets may have the Rec-10 rectifier which has practically the same output characteristics as

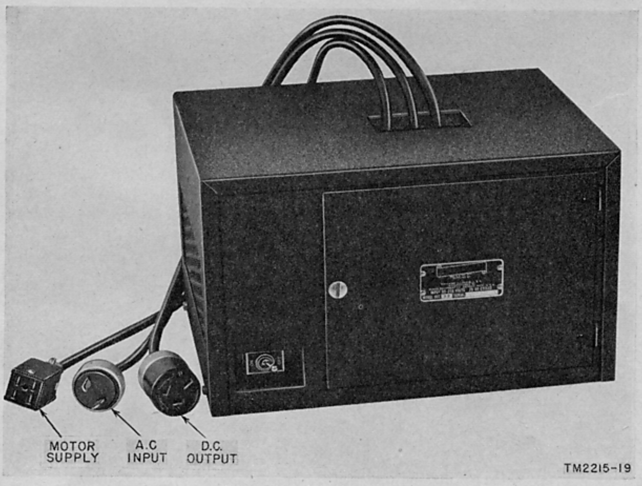

Figure 19. Rec-29 rectifier.

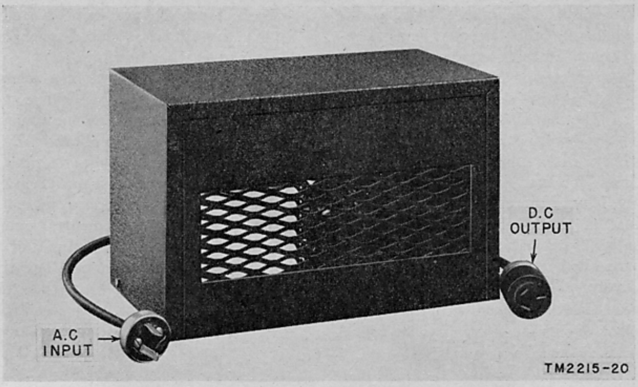

Figure 20. Rec-10 rectifier.

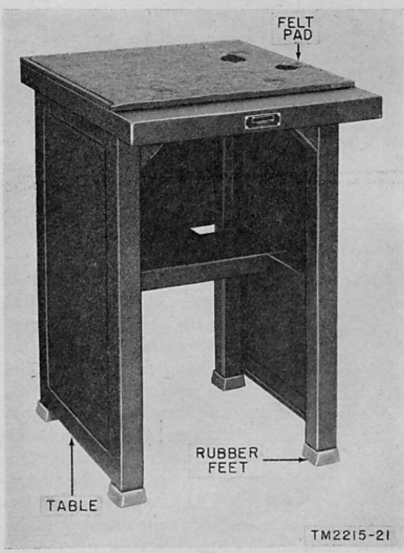

Figure 21. Teletypewriter table.

the present Rec-29. However, the Rec-10 rectifier is not adjustable for different input voltages and frequencies; it will operate only on 105- to 125-volt, $^{50}\!/_{60}$ cycle a-c.

Section III. APPLICATION

8. Teletypewriter Line Circuits

a. General. Teletypewriters TT–5/FG and TT–6/FG are receiving and direct keyboard sending teletypewriters complete with rectifiers and tables. They are designed to operate over any wire or radio circuit suitable for automatic telegraph communication at established speed.

b. Basic Teletypewriter Circuits. The simplest type of teletypewriter circuit consists of a single wire, with ground return, connecting two teletypewriter equipments. Ordinarily, this type is used only over short distances. The equipment may be used with these three general types of wire circuits: full-metallic, ground-return, and superimposed circuits. Of the superimposed circuits the most usual types are the simplex, phantom, simplexed phantom, and composited circuits.

9. Types of Operations

a. General.

(1) These teletypewriters communicate by sending and receiving a code signal known as the five-unit, start-stop code which is comprised of a series combination of seven elements for each character, function, or letter transmitted. Each of these seven elements must be either a

marking or spacing unit. The order and arrangement of the five code elements between the start and stop element depend on the character or function transmitted (five-unit, start-stop teletypewriter code). The marking elements are characteristically opposite or at least substantially different from the spacing elements; for example, when neutral operation is used there will be current flow during a mark element or impulse (usually 60 ma) and no current during a space element or interval (zero current). For polar operation the difference between mark and space will be only the direction of current flow (polarity). For polarential operation (type B) this difference will be only in the quantity of current flowing, with the same polarity for both mark and space.

Note. Of the A and B types of polarential, type B is the only one considered here.

(2) To maintain synchronism (actually relative timing) between sending and receiving units, this code series of five elements is always preceded by a space (start) element, and followed by a mark (stop) element, making a total of seven elements for each signal. The stop element is 31 milliseconds long. The other six elements are of the same duration; or 22 milliseconds each.

b. NEUTRAL.

(1) Neutral operation means operation through the use of current impulses and no-current intervals for each character or operation in accordance with the code referred to above. To send a current impulse, the contacts of the transmitter mechanism close. During the no-current intervals these contacts are held open. Transmission of a current impulse results in a marking action at the selector magnets of the receiving teletypewriter. A no-current interval results in a spacing action at the selector magnets. These five-current impulses and no-current intervals of the five-unit code are each of the same duration. In neutral operation (transmitting from a teletypewriter) the circuit is closed when marking and open when spacing.

(2) In some cases when a teletypewriter is receiving from a carrier terminal, repeater, or similar equipment, this same neutral effect is obtained by aiding batteries (d-c voltage) to give, usually, 60 ma of current for marking and opposing batteries to give zero current for spacing. For example, if neutral operation is desired when a polar signal of positive battery for marking and negative for spacing is received at the teletypewriter equipment this may be obtained in the following manner. A steady, unvarying source of negative voltage is connected to the teletypewriter in series with the selector magnets and the line (also with the transmitter contacts if single loop is used). This results in a steady marking current for the marking condition. If a negative spacing condition is supplied from the carrier or repeater terminal, this results in negative battery connected to equal negative battery or a zero current spacing condition. In this case if the teletypewriter receiving unit was grounded rather than connected to battery the operation would be on a polar instead of a neutral basis. Neutral operation is commonly used on army teletypewriter circuits between corps headquarters and headquarters at lower echelons. This type of operation also is used to cover short distances.

(3) The distance limitation of neutral circuits is imposed primarily by signal distortion resulting from varying weather conditions. Changes in weather and circuit conditions do not have the same effect on the current impulse as on the no-current interval. This type of distortion cannot be readily compensated for in the adjustment of the teletypewriter mechanism. However, this form of signal distortion can be overcome to a certain extent by interposing an adjustable receiving relay between the line and the teletypewriter. This relay may be the electrically

biased type or the mechanically biased type that is found in line units.

c. Polar. In polar operation the spacing and marking conditions are both obtained by line current impulses of equal magnitude but opposite polarity. Current flows in the signal line for both marking and spacing action. Since teletypewriters normally send only neutral type signals, some form of pole-changing equipment is connected in the circuit to change the neutral type signals generated by the transmitter contacts to the polar type signals required. Such pole-changing equipment may be a terminal or intermediate repeater. Reception of polar type signals also requires a pole-changing device at the receiving teletypewriter. Teletypewriters TT–5/FG and TT–6/FG are equipped with a polar relay (WECo type 255–A) for this purpose.

d. Polarential. A polarential circuit provides an approximate equivalent of a half-duplex polar circuit and uses only one line conductor instead of two. In a polarential circuit, transmission in one direction is polar, and in the other direction it is differential or equivalent to polar in its effect on the receiving relay armature action and contacts. The transmitting arrangements at the two terminals of a polarential circuit are different. One end, referred to as the polar sending end, applies equal voltages of opposite polarities for marking and spacing. The other end, referred to as the differential sending end, applies ground for marking and positive polarity for spacing. The two terms (polar and differential) are combined to form the term polarential. The polar relay of a teletypewriter operating on a polarential circuit responds to the differential signals as it would to polar type signals. This equivalent is attained by providing the receiving relay at the polar sending (polarential receiving) end with a local marking bias current which is midway between the marking line current and the spacing line current or equal to one-half the sum of the marking and spacing current.

(1) *Transmission limiting factors.* Generally, the limiting usable length of a telegraph circuit, whether wire or radio, has been exceeded when—

(*a*) The signals received are too weak to actuate the receiving equipment properly.

(*b*) The distortion of the telegraph impulses is too great.

(*c*) The strength of the signal received is too weak to overcome the interference. Circuits are extended by inserting repeaters before the limiting length of a circuit is reached. Repeaters used for this purpose in d-c telegraph circuits receive the signals by means of a relay and retransmit them automatically, using a local source of energy such as batteries or rectifiers. In carrier or radio telegraphy, a-c signals may be changed to d-c form before retransmission, or the repeating equipments may be vacuum tube amplifiers that merely amplify them. Regenerative (d-c) repeaters may be used at an intermediate point in a teletypewriter circuit. This type of equipment will automatically retransmit the received signals in practically perfect form, if they have not become so distorted as to cause errors in copy in a teletypewriter at the repeater point in a circuit.

(2) *D-c line sections.* The distance over which satisfactory teletypewriter communication can be maintained is limited by the characteristics of the various types of circuits and by operating conditions. Important limiting factors are line leakage, line resistance, ground resistance, waveshape distortion, and interference, The recommended limits for line sections vary.

10. General Functioning of Equipment

a. General. Specific procedures for connecting the equipment are given in chapter 2. This paragraph describes some of the functions that Teletypewriters TT–5/FG and TT–6/FG perform.

b. Transmitting and Receiving. The sending and receiving circuits of a teletypewriter may be strapped together in series to operate in a single loop circuit or may be separated into two independent circuits, one a sending circuit and the other a receiving circuit. This is accomplished at terminals Nos. 8 and 9 on the line panel of the

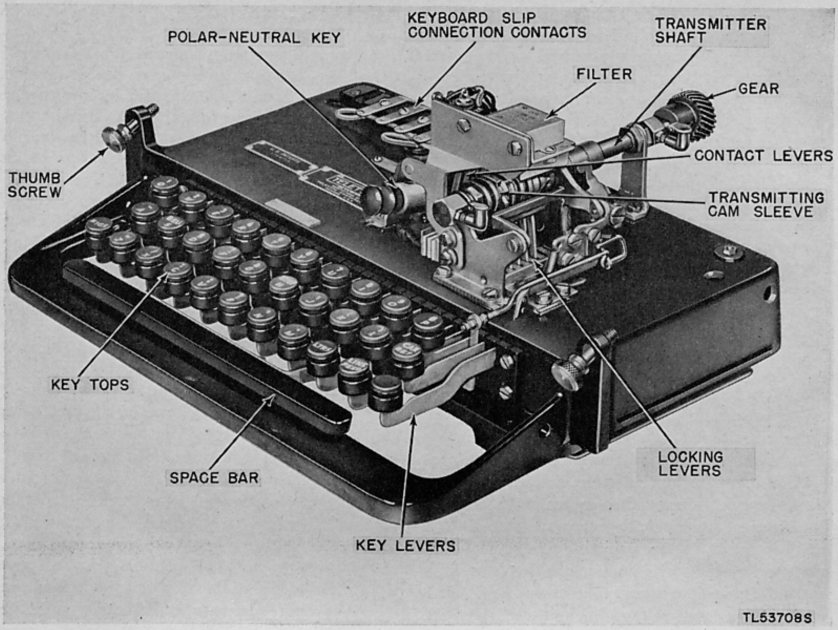

Figure 22. Transmitting mechanism.

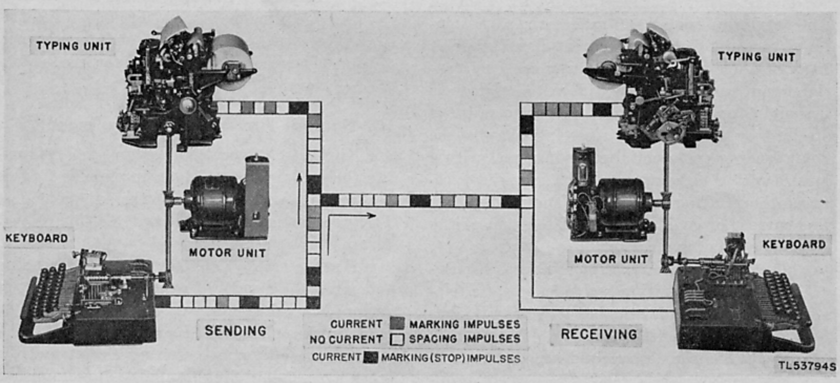

Figure 23. Diagrammatic illustration of teletypewriter transmission.

table (fig. 53). This terminal board (panel) is part of the electrical service assembly of the XRT200AA table.

c. Testing. The test jacks of the table are connected to a local test circuit preadjusted for 60 ma. The send and receive cords may be plugged into these jacks for making a local test of the teletypewriter.

d. POWER SOURCES. Refer to chapter 2 for power connections and adjustments. Any power source, either commercial or military within the required electrical characteristics, can be used.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

11. General

a. Installation of Teletypewriters. Installation of the teletypewriters consists of the following steps:

(1) Selection of a suitable location.
(2) Unpacking and setting up the equipment.
(3) Connection to power source.
(4) Completion of connections to signal lines and preparation for operation.

b. Selection of a Suitable Location. Because these teletypewriters are fixed plant equipments, the following information is intended only as a general guide. Specific data for installing circuits into which the equipments work are contained in TM 11–486. Details for station lay-out are given in TM 11–2207.

(1) *Determining site.* The suitability of exact location depends upon the necessity for keeping the station hidden, the housing facilities or shelter available, and the type of terrain. Whenever possible, select a location where the equipment can be set upon a flat level surface. If necessary, grade the ground and, if a building is not available, provide a wooden platform and a suitable shelter. Drainage around the shelter must be adequate to prevent flooding during wet weather. If ground-return circuits are used, be sure that the station is set up near a suitable ground.

(2) *Shelter.* When the shelter has been arranged, take precautions for blackout operation.

(3) *Space.* Allow enough room around the equipment to permit free access to the back of the table (or at least 10 inches to swing cover back) by installation and maintenance personnel, and for the operator to check the range at the left of teletypewriter.

(4) *Lighting.* Provide adequate light for the operator. Arrange a drop cord that can be used by maintenance personnel.

(5) *Special considerations.* For techniques to be applied to protect the equipment under extreme weather conditions, refer to the following publications: TB SIG 13, TB SIG 66, TB SIG 69, TB SIG 72, and TB SIG 75.

12. Uncrating, Unpacking, and Checking

a. General. When unpacking these equipments, follow the sequence outlined in *b* through *e* below. Be careful not to damage any of the items by handling packages roughly. Always use a nail puller to remove nails. Never try to pry off the top or sides of a shipping container. Cut the metal strapping that secures each package and be sure to bend back each cut end so that it will not harm equipment or personnel. Always clean and inspect each item before setting it aside for assembly. Note any damage that may have occurred during shipment. Check all items against the packing list. Remove all traces of packing material such as excelsior. Do not remove instruction tags until ready to install an item in its operating position. Refer to paragraph 4 for contents and size of each package. Save all packing materials; they may be required for repacking.

Caution: Contents of metal container and boxes are inflammable. One packing slip is tacked to the outside of the box and one is placed inside under the cover. Each packing slip is sealed in a moisture-vaporproof foil-lined envelope. Stenciled on the outside of each box are the code number of the inclosed set, the set number indicating

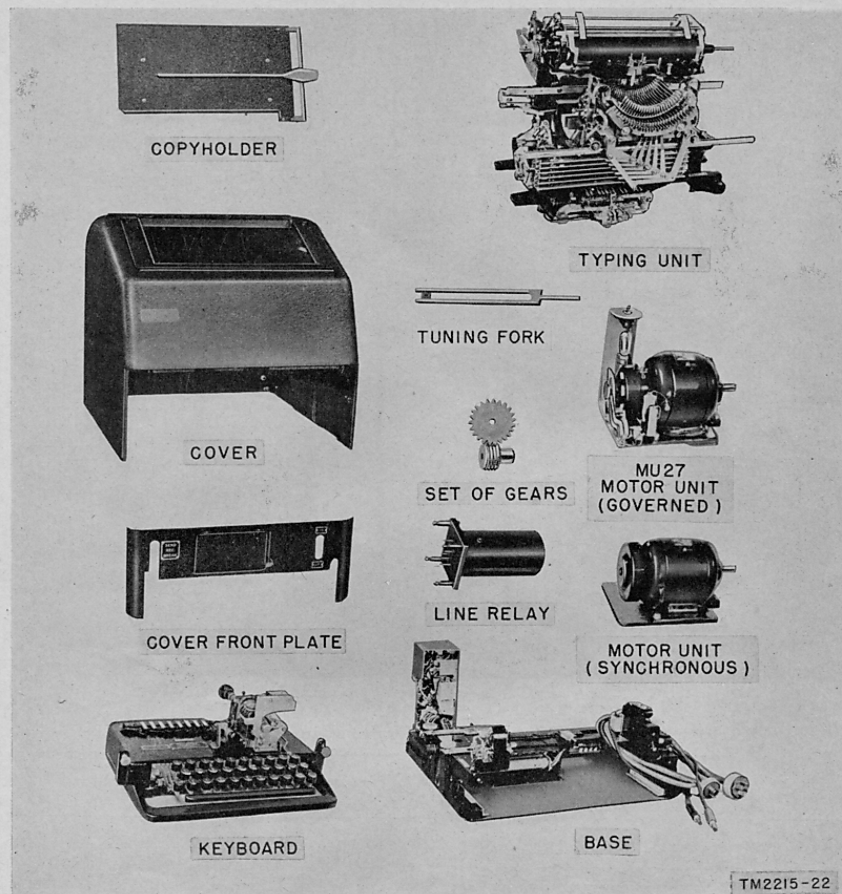

Figure 24. Model 15 teletypewriter components.

number of sets in a particular order or shipment, and the box number marked over the total number of boxes required for one set. For example, 1/4 indicates box one out of a total of four required to make up one complete set, such as a Teletypewriter TT–5/FG or TT–6/FG.

b. First Package To Be Opened. Open box No. 2 and the cardboard carton marked PK–11292 first. The No. 2 box (2/4) also contains the base unit BB44G. This box weighs approximately 233 pounds (24.6 cubic feet). Proceed as follows:

(1) Remove one side (either front or back) and the top of the shipping container (box).

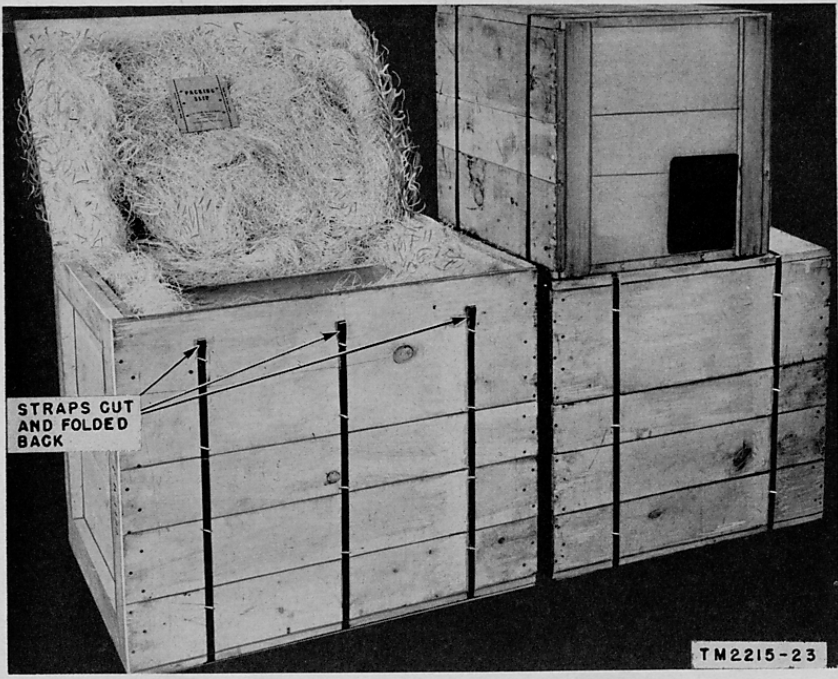

Figure 25. Typical oversea shipping container.

Teletypewriter TT–5/FG or TT–6/FG. For complete list refer to chapter 1

Box No.	Box PK No.	Contents	Fiber-board carton PK No.	Metal bands per box	Distance of outer bands from ends (in.)	Dimensions (in.) length, width, height	Approx. gross wt. per box (lb.)
1/4	1156	Typing unit	11289	2	4½	30½ x 28 x 30½	159
2/4	1260	Table	11292	3	8 (one in center)	50¼ x 27 x 31¼	233
		Base unit	11363				
3/4	801	Rectifier	10719	3	7 (one in center)	45½ x 21½ x 18½	173
		Keyboard	10746				
4/4	798	Consolidated package of parts and spare parts.	9518	2	5½	38½ x 21¼ x 31¼	181
		Relay	8741				
		Electrical service assembly	8985				
		Copyholder	8540				
		Cover front plate	8542				
		Motor unit	10568				
		Cover	10927				

Note. Locate staples at intervals of 6 inches on all strapping.

(2) Carefully open the moisture-vaporproof barrier materials, and remove the cushion wrappings. Open the carton from the top rear right.

(3) Remove the wooden frame from the top of the table.

(4) Lift the table out of the carton and set it near its operating location. Replace all wooden frames and packing details in cartons for future use.

Caution: The contents of the metal containers are inflammable. To open, force the upper edge of one side of the metal box away from the soldered seam that holds it in place (fig. 28). Use a soldering iron to wipe off excess solder. Do not leave any exposed sharp or rough edges.

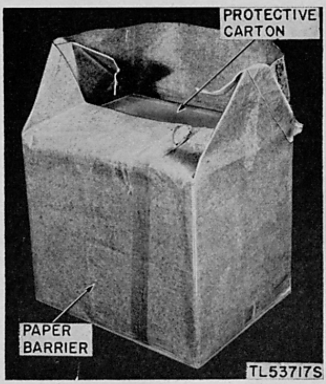

Figure 26. Typical paper barrier.

c. Second Package. This consolidated package normally is marked 4/4 but, preferably, should be opened second. It has an average gross weight of approximately 181 pounds and displaces 14.6 cubic feet. It contains the electrical service assembly, motor unit, teletypewriter cover, line relay, gear set, speed indicator, copyholder, cover front plate, parts, spare parts, and technical manuals. Refer to paragraph 4 for detailed list and packaging information.

(1) Open the shipping container and remove each carton of equipment.

(2) Open each carton and metal container. Within the outer (secondary) container there is a sealed, watertight (primary) inner carton.

(3) Open each inner carton and remove all cushioning, barrier materials, and the desiccant (water-absorbing material).

(4) Carefully lift out each item of equipment. Place each item on the table or wooden box and protect it from dust, etc.

d. Third Package. This package contains the typing unit (4TBP22/210 for general communication or 4TBP93/221 for weather communication) and is marked 1/4. The average gross weight is approximately 159 pounds and the displacement is 15 cubic feet.

(1) After the metal straps and the nails that hold the front of the case to the top have been removed, take off the top and front of the case.

(2) Remove the excelsior packing material.

(3) Take the metal box out of the container.

(4) Open the metal box by forcing the upper edge away from the seam as directed in *b* above.

(5) Pry the top cover out.

(6) Cut the edges of the sides of the metal container and bend them down.

(7) Carefully lift out the fiberboard carton that contains the typing unit.

(8) Open the carton and remove the desiccant and desiccant tray.

(9) Lift out the typing unit with its crate.

(10) Set the unit in an upright position.

(11) Remove the wedge locks from each side.

(12) Remove the two screws from each of the four vertical corner members of the crate.

(13) Remove the crate from around the typing unit.

(14) Remove the two wood screws that hold the wooden top frame to the wooden front frame. Remove the front and top frames.

(15) Remove the tie cord and paper packing from the type-bar carriage.

(16) Detach the parts bag and remove the paper reel spindle, platen crank, and ribbon spools. Set these parts aside until the typing unit has been set up.

(17) Remove the brackets (figs. 31 and 37)

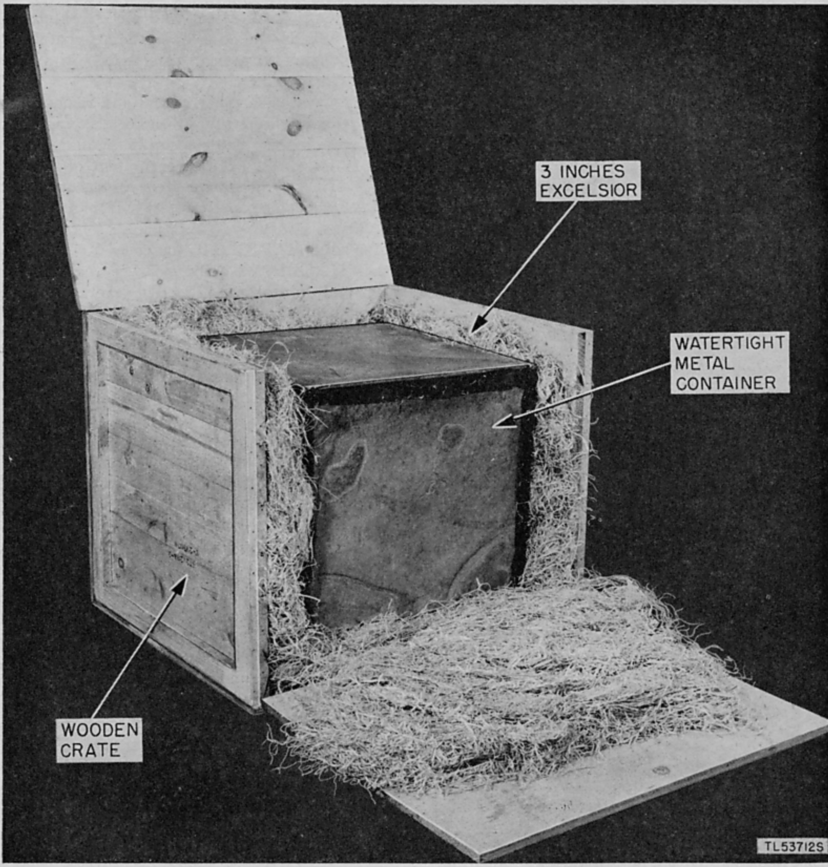

Figure 27. Metal-sealed typing unit in shipping container.

that hold the carriage in place for shipping. These brackets are located on each side of the typing unit over carriage track supports.

(18) Remove the cord that holds the bell at the rear of the unit.

(19) Set aside the typing unit, until attached to its wooden base, until ready to install it upon the base unit on the table. Cover the typing unit to prevent dust and dirt from reaching the internal mechanism.

e. Fourth Package. This package contains the rectifier power unit, Rec-29, and the keyboard. The shipping box is marked 3/4 on the outside and weighs approximately 173 pounds with a cubic displacement of 10.5 cubic feet.

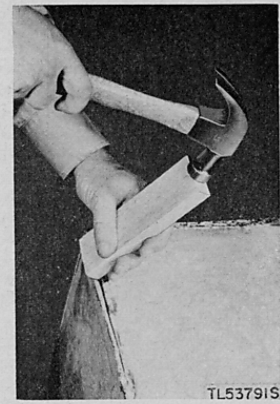

Figure 28. Opening metal container with wooden block.

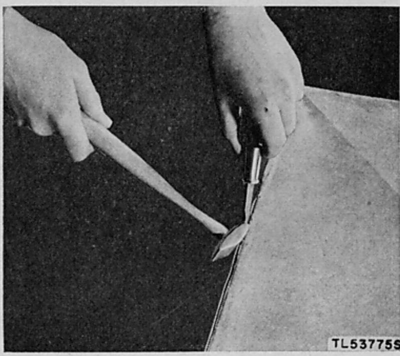

Figure 29. Opening metal container with screw driver.

(1) Remove the outer containers to and including the metal cans.

(2) Remove the cartons, cushioning, and protective wrappings from around the rectifier and keyboard.

(3) Lift the rectifier from the carton and, after removing the desiccant, set the rectifier near or on the shelf in the front of the table.

(4) Lift out the keyboard and insert it in the front of the base, or set it aside and cover it to protect it from dust until ready to use.

f. CHECKING. Check the components against the list given in paragraph 4. When necessary to make repairs beyond the authority of the operator or installing crew, refer to the local maintenance organization.

13. Assembly and Installation

Before installing the operating components on the table, set the table in its working location. Information on the completion of the power and signal line connections at the table is covered in section III of this chapter. Assemble the equipment in the order given below.

a. ELECTRICAL SERVICE ASSEMBLY. Bolt the electrical service assembly in place under the top of the table (fig. 44).

b. RECTIFIER POWER UNIT. Set this unit upon the shelf in the front of the table. Refer to paragraph 20*c* for adjustments that must be made before this unit is installed.

c. BASE. On top of the table there is a felt pad held in place by three steel channels (fig. 44). Set the base in place as follows:

(1) Lift the base carefully and lower the back edge onto the pad. Hold up the front edge until the cables and cords attached to the connection strips have been fed through the cut-out in the pad and table top. Lower the base in place.

(2) Aline the base so that its edges are parallel to the edges of the table.

(3) Check that the line relay is in place (fig. 32).

(4) Check that the plug-type fuse is properly screwed into its receptacle (fig. 32).

d. MOTOR UNIT.

(1) Remove the three motor mounting screws from the motor unit mounting, at the right rear corner of the base.

(2) Remove the screw and lockwasher in the end of the motor shaft.

(3) Obtain the steel pinion that is packaged with the bakelite main shaft gear (box number 4/4).

(4) Assemble the steel pinion on the motor shaft, using the screw and lockwasher mentioned in (2) above.

(5) Set the motor unit in place and slide it in against the spring contacts.

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(6) Insert and tighten the two front mounting screws, then back them off about one-fourth of a turn. Do not tighten the rear mounting screw until the typing unit has been set in place. Examine the target lamp for damage.

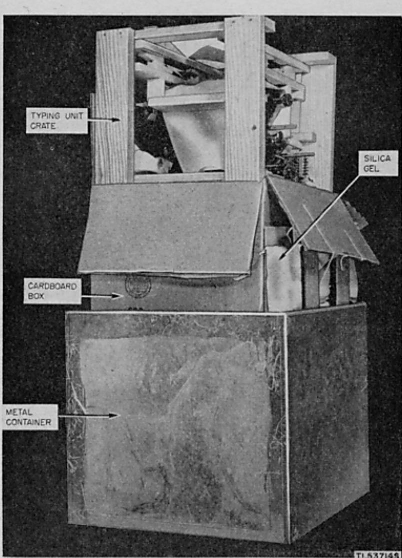


Figure 30. Removing typing unit from metal container.

e. Typing Unit. Remove the typing unit form from its wooden shipping base. Underneath the typing unit are two hexagonal studs. These studs enter clearance holes in the base and are used only to protect the typing unit mechanism from injury when it is removed from the teletypewriter.

(1) Remove the oil-retaining plug from the right end of the main shaft.

(2) Remove the clamping screw and lockwasher that hold the gear hub to the shaft, and slide the gear hub off the shaft.

(3) Remove the three screws and lockwashers from the hub, and assemble the gear and hub by inserting the three screws and lockwashers through the counterbored holes in the gear.

(4) Slip the gear and hub onto the main shaft so that the hub is toward the outside of the typing unit. Slide the assembled gear and hub along the shaft until the slot in the main shaft permits the hub-clamping screw with its lockwasher to be fastened in place.

(5) Remove the three large flat thumbscrews from the base.

(6) The exact location of the typing unit upon the base (fig. 33) is determined by two dowel pins on the two forward machined surfaces of the base unit. The right dowel pin fits into a hole, and the left dowel pin enters a slot in the typing unit casting.

Caution: When setting the typing unit upon the base, be careful not to jam the bakelite main shaft gear against the steel pinion on the motor shaft. Face the front of the typing unit. With the right hand, grasp the flat projection on the right-hand typing unit casting (fig. 33); with the left hand, take hold of the extreme left lower front corner of the left-hand typing unit casting. Lift the typing unit carefully. Do not place undue strain upon the unit. This may cause the mechanism to be thrown out of alinement.

(7) Place the typing unit upon the base by setting the left side down first. Hold the right side so that the main shaft gear is just ready to mesh with the motor pinion.

(8) With the left hand, turn the motor flywheel and at the same time carefully lower the right end of the typing unit until the motor pinion meshes properly with the main shaft gear.

(9) Check the alinement of the motor pinion and main shaft gear by looking through the opening at the front bottom of the typing unit. (This is the opening into which the keyboard will be installed.) A vertical line drawn through the center of the motor pinion should bisect the gear face of the main shaft gear (fig. 34). Loosen the four motor base bolts and move the motor unit very carefully on its base plate if it is necessary to improve lateral alinement between gear and

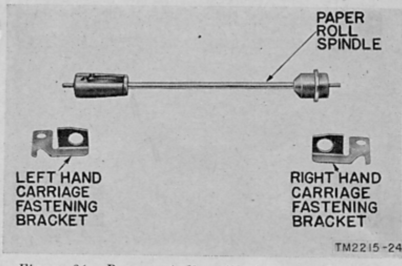


Figure 31. Paper spindle with fastening brackets.

pinion. If the alinement appears satisfactory, tighten the four motor base bolts and insert the three thumbscrews that hold the typing unit to the base. Tighten the three-motor-unit base plate mounting screws. Then tighten the three thumbscrews to secure the typing unit to the base unit.

(10) Check the motor pinion and the main shaft gear adjustment by turning the flywheel of the motor by hand. The proper adjustment is achieved when the amount of backlash is just barely perceptible. Install the paper spindle.

f. KEYBOARD-TRANSMITTER. This keyboard assembly includes the transmitter and fits into the opening in front of the base and part of the typing unit (fig. 35).

Caution: Handle carefully. When mounting the keyboard-transmitter into the base unit, be very careful not to jam the bakelite gear on the transmitter shaft against the steel gear with which it meshes on the main shaft of the typing unit. The keyboard-transmitter unit slides into the opening in front of the base upon two angle irons which act as rails. Two plates, fastened under the keyboard (on the right and left sides) go *under* the rails.

(1) Slide the assembly into place slowly, and at the same time rotate the motor flywheel

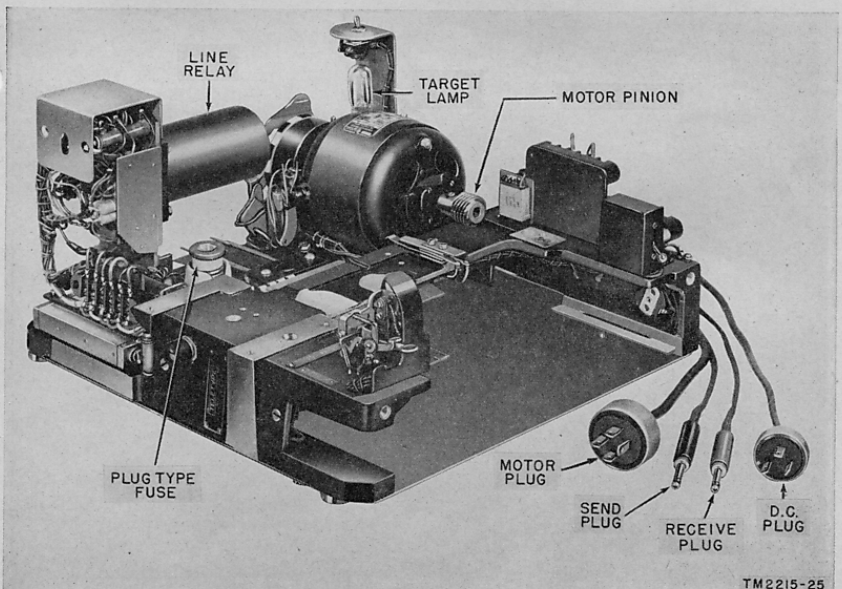


Figure 32. Line relay and plug-type fuse in place.

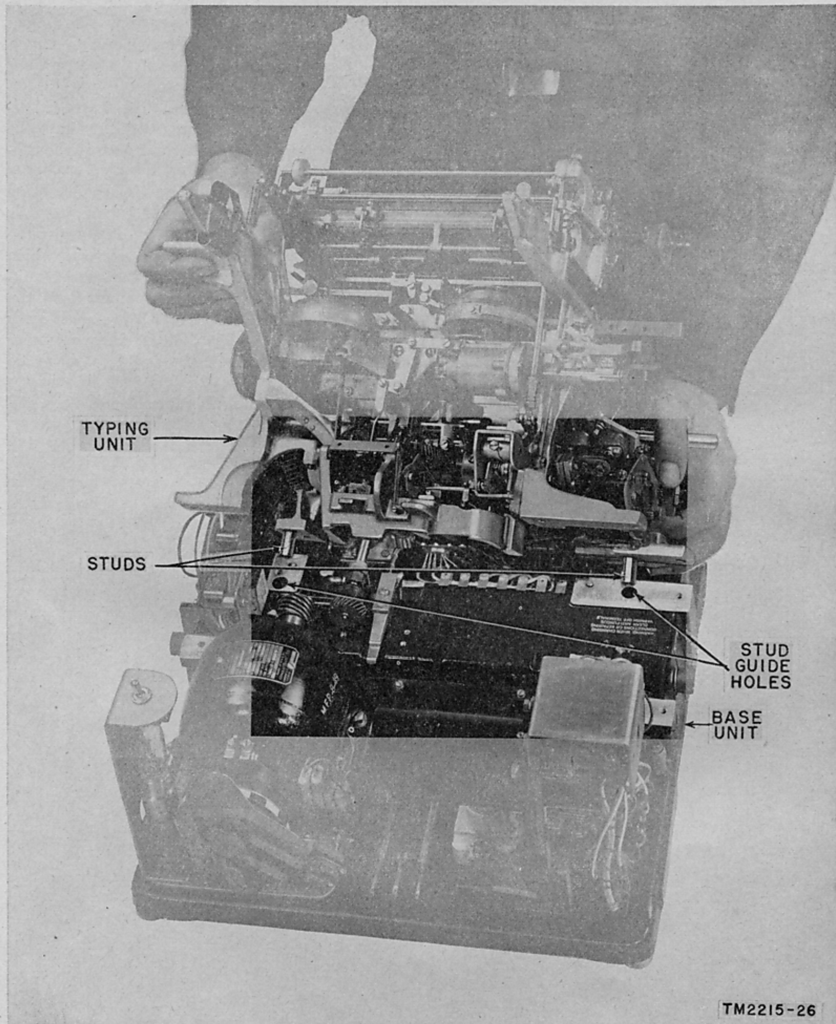


Figure 33. Lowering typing unit onto base.

back and forth by hand so that the transmitting shaft gear will mesh properly with the steel gear on the main shaft of the typing unit.

(2) When the keyboard-transmitter assembly is in place, tighten the two captive thumbscrews (fig. 35) which hold the keyboard to the base unit.

14. Installation of Ribbon and Paper

a. Ribbon. Make sure that the ribbon (figs. 36 and 38) has a hook fastened to each end and that it has a reversing eyelet about 4 inches from the hooks at both ends. The ribbon spool may be of either metal or fiber, but it must have small holes in the flange, spaced around the center hole to engage the ribbon spool driving pin on the ribbon spool shaft. Proceed as follows:

(1) Open the glass panel and the metal top that are hinged to the top of the typing unit cover. Remove the empty spool. Engage the hook at one end of the ribbon

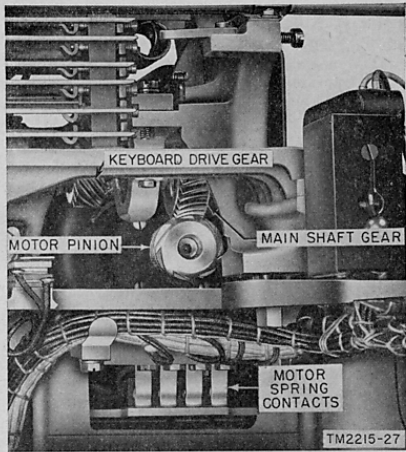


Figure 34. View of gears in place on unit.

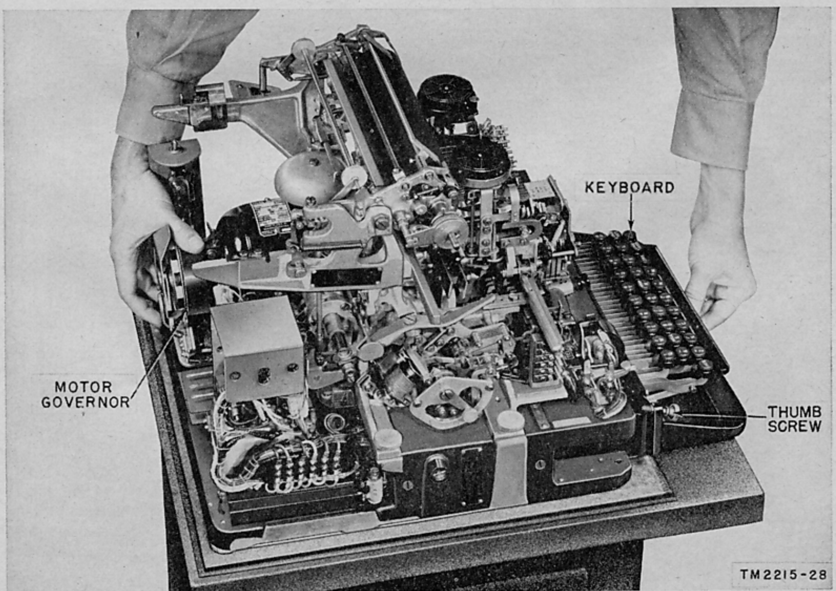


Figure 35. Sliding keyboard into front of base and typing unit while rotating motor by hand.

in the hub of the empty spool. Wind a few turns of ribbon onto the spool to make sure that the reversing eyelet has been wound upon the spool.

(2) Place the ribbon spools on the shafts so that the ribbon feeds from the back of each spool without twisting. Turn each spool slightly until the driving pin on the ribbon spool shaft is engaged by one of of the holes in the flange.

(3) Thread the ribbon forward around both ribbon rollers, through the slots in the ribbon reverse arms, across the ribbon carrier, and under the carrier hooks (fig. 36 and 38).

(4) Be sure that the ribbon remains in the slots and that both reversing eyelets are between the ribbon spools and the ribbon reverse arms. Eliminate any slack in the ribbon.

b. PAPER. Open the glass plate of the typing unit cover and the metal lid hinged to the top. Push back the paper-spindle retaining plates (fig. 40) and remove the spindle. Insert the spindle in the roll of paper.

(1) With the paper feeding from the bottom front of the roll, place the spindle in the left-hand groove (viewed from the rear) first and then in the right-hand groove.

(2) Push the retaining plates back to lock the spindle in place.

(3) Feed the paper over the paper straightener rod and fold the end of the paper back to square it off.

(4) Bring the paper up under the paper fingers by turning the platen crank. Do not disturb the ribbon.

(5) Push the pressure-roller-release shaft arm back (fig. 43).

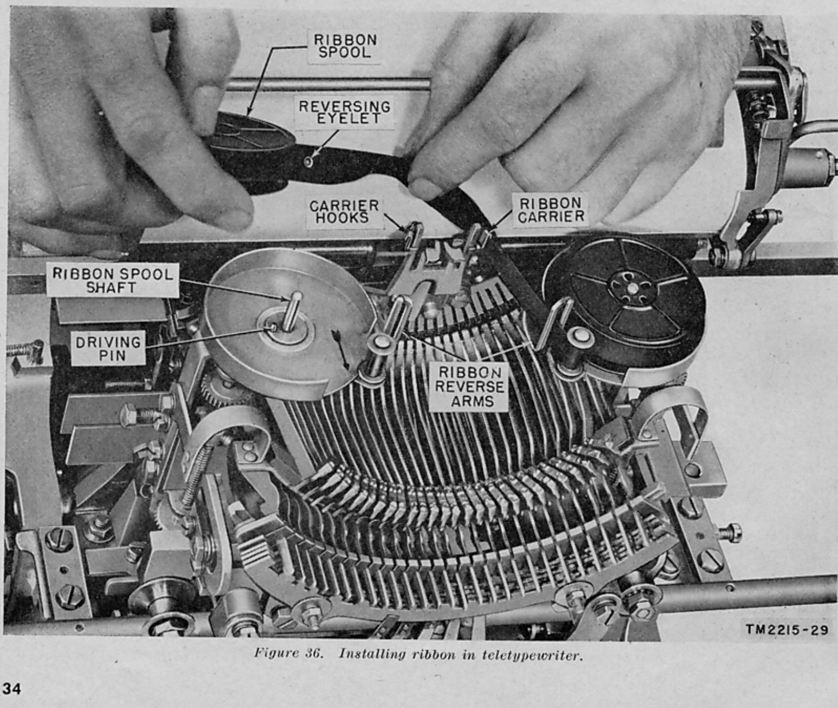


Figure 36. Installing ribbon in teletypewriter.

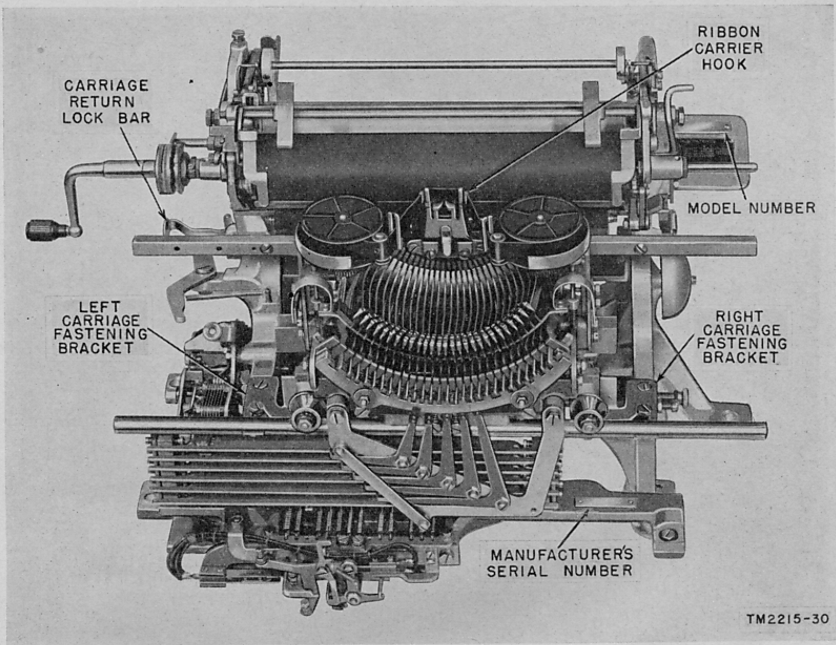


Figure 37. Front of typing unit.

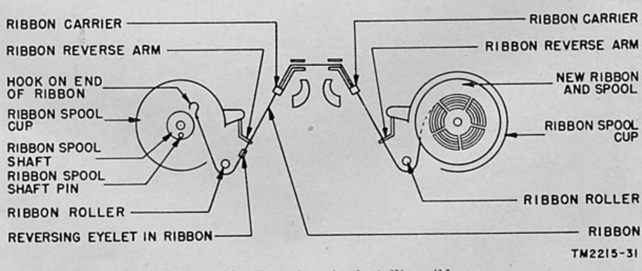


Figure 38. Procedure for installing ribbon.

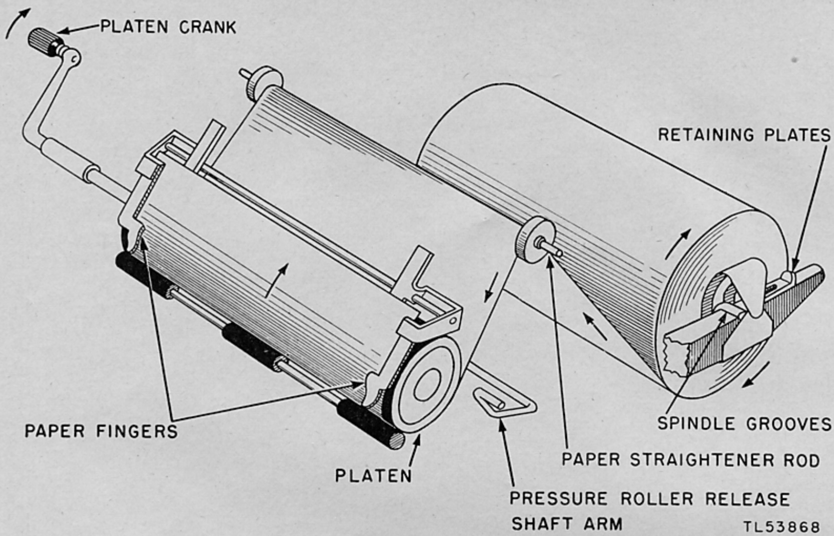


Figure 39. Procedure for installing paper.

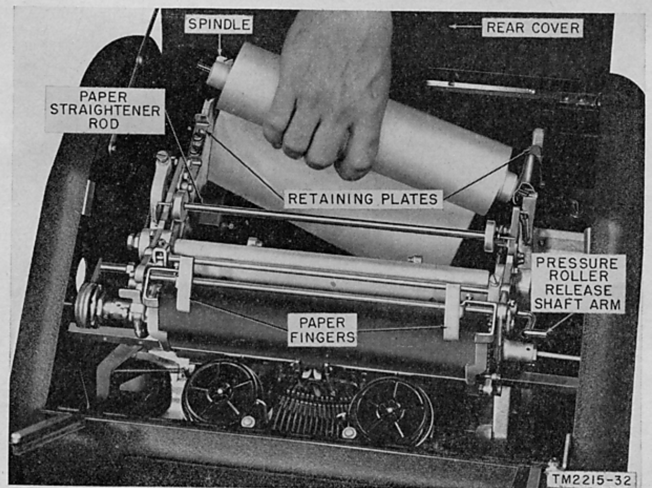


Figure 40. Step 1—installing paper in teletypewriter.

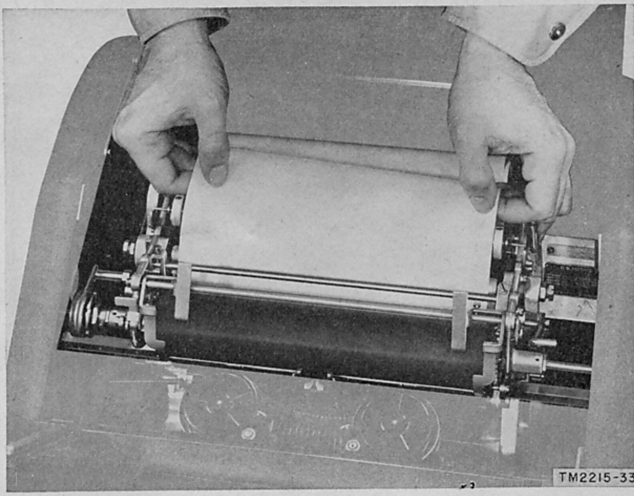


Figure 41. Step 2—starting paper through rollers.

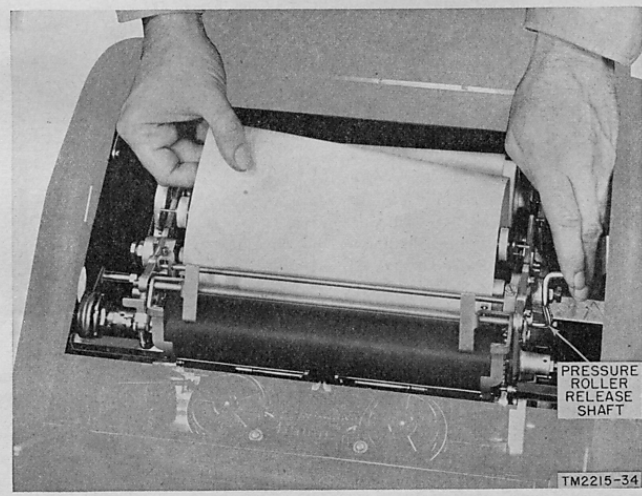


Figure 42. Step 3—releasing tension of platen pressure rollers and moving paper through rollers.

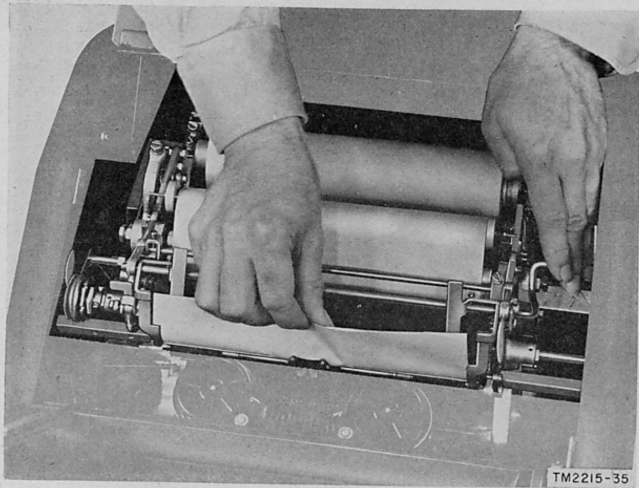


Figure 43. Step 4—pulling paper in place with tension released.

(6) Straighten the paper as in an ordinary typewriter and pull the arm forward.

(7) Close the hinged lid of the typing unit cover and roll the paper up over it, using the platen crank. Close the glass front cover.

c. Typing Unit Cover and Parts. Bolt the cover front plate in position in front of the cover. Attach the copyholder to the cover by means of the four flathead machine screws provided. Set the typing unit cover over the assembled equipment so that its sides are parallel with the edges of the table. Do not use force. Insert the platen crank for the paper through its aperture in the left side of the typing unit cover. The teletypewriter set completely assembled is shown in figure 44.

15. Physical Checks and Adjustments

During and immediately after assembly, but before power and signal line connections are made, examine each component carefully. See that all dust, dirt, and packing debris is cleaned away. Lubricate the equipment according to instructions given in paragraph 43. If major repairs are required, refer the equipment to the local maintenance unit.

a. Mechanical Parts. Carefully examine all parts for damage. Look for dents in metal covers and worn spots or scratches on painted surfaces. See that the glass plate in front of the typing unit cover is not cracked, chipped, or broken, and that the tearing edge of the plate is straight. Check all switches and controls to make sure that they move easily and are in good operating condition.

b. Electrical Parts. Examine all electrical terminals, receptacles, and cords for wear; check for breaks and other damage. Check all screws on the power and line terminal boards. See that all fusing devices are of the correct electrical values and see that they are properly installed. Examine all electrical contacts and see that they make good electrical connection. Check the ground screws on each item of equipment.

c. Supplies. Be sure that the paper and ribbon are correctly installed, and make sure that they operate satisfactorily in their carriers.

d. Protection. Be sure that the moistureproof ing and fungiproofing coatings are intact. If they are not, refer to paragraph 45. Check for proper lubrication.

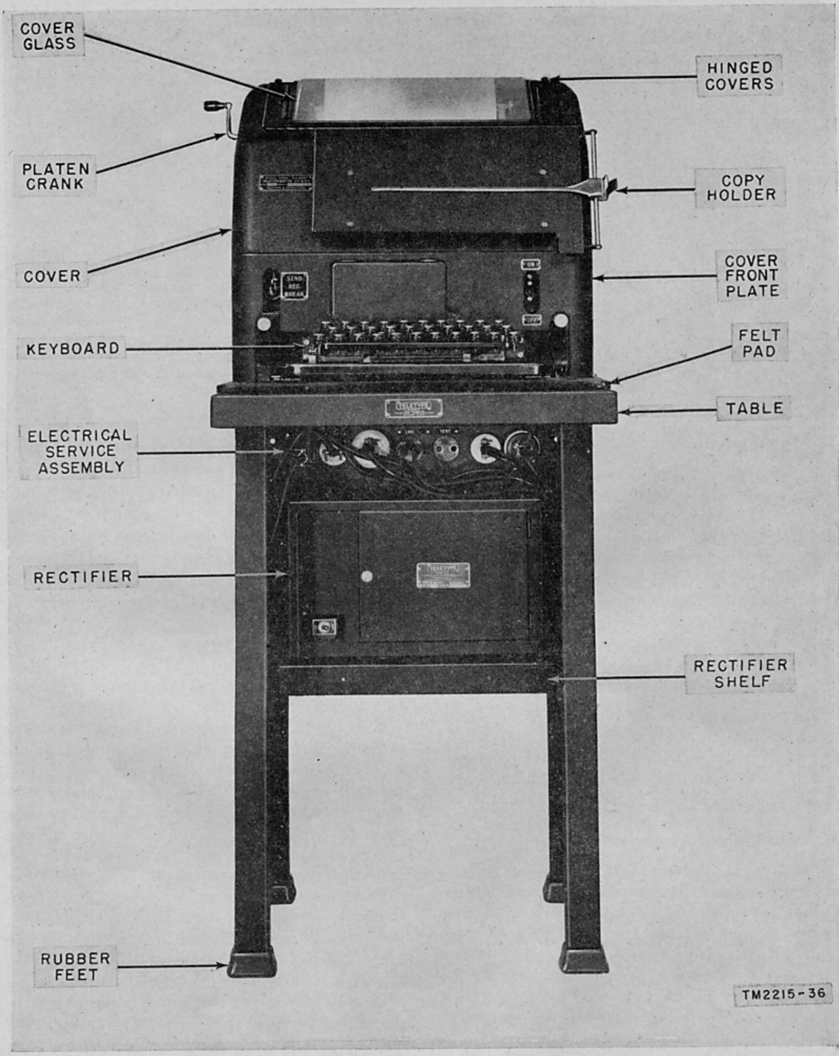


Figure 44. Assembled teletypewriter set.

Section II. CONTROLS AND INSTRUMENTS

16. Teletypewriter Controls

Controls on Teletypewriter TT–5/FG and Teletypewriter TT–6/FG are as follows:

Control	Where located	Function
Rectifier power unit control ON-OFF switch.	Lower front left-hand corner of rectifier (fig. 19).	Controls a-c power to rectifier.
Motor ON-OFF switch	On the base above right end of keyboard.	Controls a-c power to motor unit.
SEND REC BREAK key	On the base above left end of keyboard.	When operated to BREAK, starts teletypewriter when remote motor stop function is performed, also furnishes signal to distant operators; in SEND position, arranges teletypewriter for sending or receiving; in REC position, arranges teletypewriter for receiving only.
Polar-neutral key	Behind a metal flap above front center of keyboard.	When pulled out, teletypewriter is arranged for neutral reception. When pushed in, teletypewriter is arranged for polar reception.

17. Instruments

Issued with Tool Equipment TE–50–A (which is shipped with Teletypewriters TT–5/FG and TT–6/FG) are two tuning forks with which to check the speed of the motor unit. One of these, the use of which is described in later sections of this manual, is of the type which vibrates 87.6 times a second for adjustment of motors used with American teletypewriter equipment. The other vibrates 96.1 times per second and is used when motor speed is adjusted for interoperation of American and British teletypewriter equipment. Refer to paragraph 22*b* for instructions on adjusting motor speeds, and refer to appendix III for adjustment when American and British teletypewriter equipment is arranged for interoperation.

Section III. OPERATION UNDER USUAL CONDITIONS

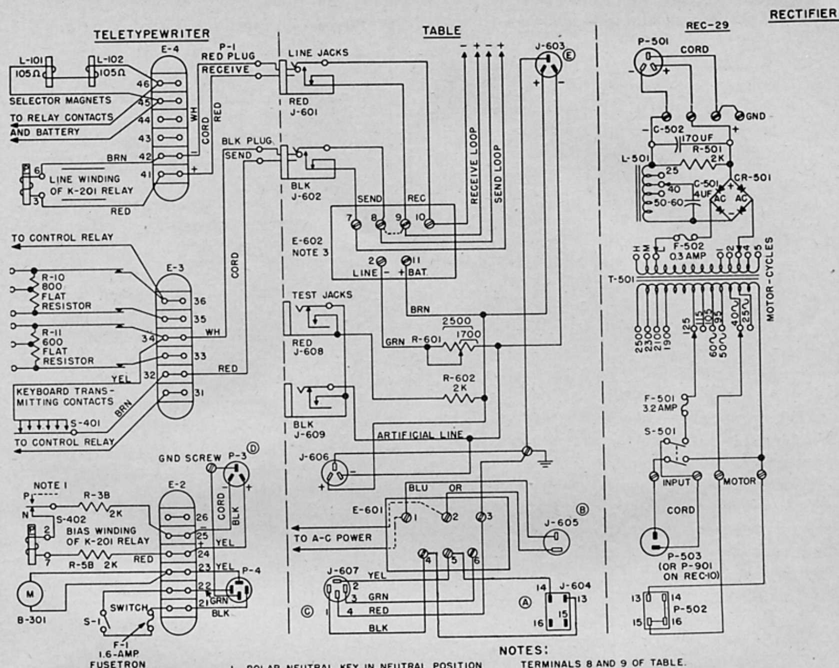
18. Equipment Connections

Figure 45 is an over-all schematic of the equipment connections made to Teletypewriter TT–5/FG and Teletypewriter TT–6/FG. Paragraphs which follow describe procedures for making specific connections.

19. Grounding Arrangements

a. GENERAL. Stations at which these equipments are operated must have good grounding facilities. One or more grounds are required to provide protection against damage from lightning or other high-voltage sources, to reduce cross-fire interference, and to complete ground-return paths for d-c telegraph circuits. Each item of equipment must be connected to a low-resistance ground. The grounding point should be as conveniently close to the equipment as possible. The procedure for establishing grounding facilities for protection is the same as that required to establish a ground-return connection. Refer to TM 11–676.

b. ESTABLISHING GROUNDING FACILITIES. For satisfactory operation of teletypewriter circuits which use ground return, a low-resistance ground must be established. This is particularly true where a single ground connection is used to serve more than one line. A high-resistance ground acts as a coupling between circuits and this causes cross-fire effects between them. Whenever possible, connect the ground lead from the teletypewriter equipment to a water pipe or similar low-resistance ground. It is advantageous to do this even if it requires a considerable length of line. If such a connection is not possible, drive ground rods deep into damp earth and connect them to the equipment with field wire. The ground rods may be installed at a considerable distance from the teletypewriter equipment, and the grounding point may be as far as 1,000 feet away, if neces-



NOTES:

1 POLAR NEUTRAL KEY IN NEUTRAL POSITION
2 CONNECTIONS ARE SHOWN FOR EITHER THE REC-29 OR THE REC-10 RECTIFIER.
3 IF SENDING AND RECEIVING LOOPS ARE USED, WIRE AS SHOWN WITH STRAP REMOVED FROM TERMINALS 8 AND 9 OF TABLE.
IF A SINGLE LOOP IS USED, CONNECT TO TERMINALS 7 AND 10 OF TABLE AND STRAP 8 AND 9.
CONNECT LINE BATTERY AND GROUND AT TABLE IF REQUIRED, GROUND MAY BE SUBSTITUTED FOR ONE WIRE OF ANY PAIR BETWEEN STATIONS WHEN NECESSARY.

TM 2215-56

Figure 45. Equipment connection diagram.

sary. Drive ground rods so that the best possible contact is made with the earth. When driving a ground rod, be careful that it does not whip. Whipping will loosen the soil and result in a poor contact. To make the best possible connection, the earth must be packed against the rod from the surface of the ground to the bottom of the rod. To establish a good ground connection, proceed as follows:

(1) Select the lowest and dampest spot in the vicinity. Clay or loamy soil is best.
(2) Prepare a hole about 6 inches deep.
(3) Drive a ground rod, the surface of which is free from paint or grease, into the hole until the top of the rod is about 3 inches above the surface of the earth around the hole.
(4) Clamp the ground lead wire securely to the ground rod. Saturate the earth around the ground rod with water. Then fill in the hole, covering the top of the rod. Pour water over the spot as frequently as necessary to keep the earth moist at all times.
(5) If a satisfactory low-resistance ground cannot be obtained with one ground rod, use several additional rods at the same location and connect them in parallel.

Do not space the rods less than 10 feet apart.

(6) If a multiple ground rod arrangement does not give the desired results, it will be necessary to give the soil around each ground rod special treatment. Such treatment is as follows: Dig a hole about 3 feet in diameter and 1 foot deep around each ground rod. Make a brine solution (5 pounds of salt to 5 gallons of water) for each rod. Pour the solution into each hole and permit it to seep into the earth. After approximately one-half hour, or as soon as the brine solution has seeped into the soil, check the electrical connections again and then fill the hole over each ground rod. Pack the earth down as solidly as possible.

c. Testing for Good Ground Conditions. It is not practicable to test single ground connections to water pipes and similar facilities. If the efficiency of such a ground arrangement is in doubt, install a ground rod or other separate ground. Tests for determining conditions under which a satisfactory ground can be established are contained in TM 11–486 and in TM 11–676. A test of the earth's resistivity can be made as follows:

(1) Drive two ground rods, 5 feet apart, into the earth to a depth of 5 feet.

(2) Connect a suitable wire lead to the exposed top of each ground rod.

(3) Connect these leads to Test Set I–49 or equivalent test equipment.

(4) Take the reading (in ohms) on the meter; reverse the wire leads at the test set, and take the reading again.

(5) Compute the average of the two readings. The resistance between ground rods (in ohms) is about equal to the resistivity of the earth between the two points, measured in meter-ohms. Resistivities may be rated as follows:

(*a*) Low—up to 100 meter-ohms (100 ohms as read on Test Set I–49).

(*b*) Medium—approximately 300 meter-ohms (300 ohms as read on Text Set I–49).

(*c*) High—1,000 meter-ohms and higher (1,000 ohms as read on Text Set I–49).

20. Power Connections
(fig. 45)

a. General. The total maximum power required to operate these teletypewriters is about 200 watts. The rectifier power unit (Signal Corps stock No. 4TREC29) is designed to operate from an a-c source of 95, 105, 115, 125, 190, 210, 230, or 250 volts at 25, 40, 50, or 60 cycles. This rectifier power unit also delivers the required adjusted a-c motor voltages suitable for one or two motors. In addition, it delivers filtered d-c for operation of the local d-c circuits of the teletypewriter and line current, if required (figs. 50 and 51). The Rec-10 rectifier, if used, has no adjustment for input cycles and does not supply motor voltage. There is no fuse installed in the a-c side of this rectifier unless by special wiring. When rectifier Rec-10 is used, it is suggested that for protection of the equipment a 3.2-ampere fuse be installed on the incoming power line in series with the primary winding of the transformer. Otherwise, it is similar to the Rec-29 rectifier.

b. Checking Power Source. Determine the voltage and frequency of the power available at the installation before making any connections to the equipment. When necessary, request the local maintenance organization to conduct the necessary tests to determine the characteristics of the power source.

c. Installing Rectifier Power Unit (figs. 48 and 49).

(1) Check all power switches to be sure they are in their OFF positions. The voltage of the transformer secondary is 300 volts.

(2) Open the hinged cover of the (Rec-29) rectifier power supply unit or remove the cover of the Rec-10 power supply unit to make adjustments, and check the panel terminals.

(3) Be sure that proper fuses are installed in the rectifier panel, in the teletypewriter base, and any other equipment when required.

(4) Remove or open the rectifier cover; this depends on which type of rectifier is used. Disconnect the a-c power source and check the cord terminations on the panel at the rear of the rectifier. When in the OFF position, the double-pole switch of

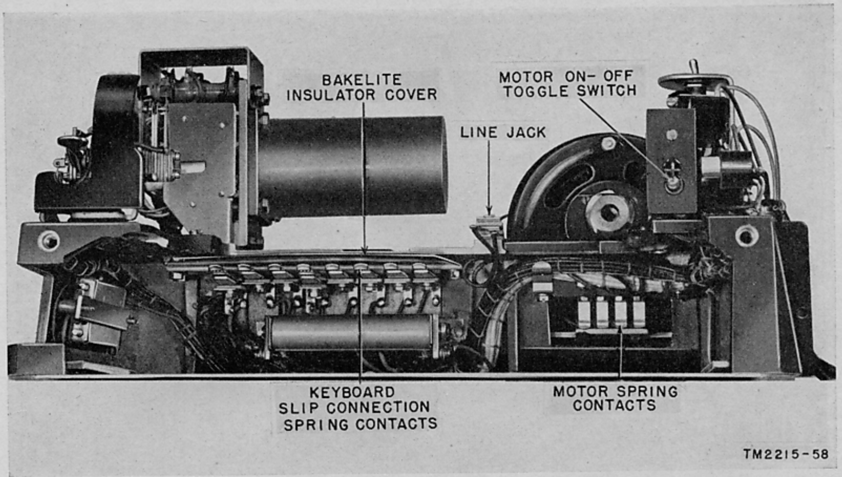


Figure 46. Keyboard and motor contacts on base.

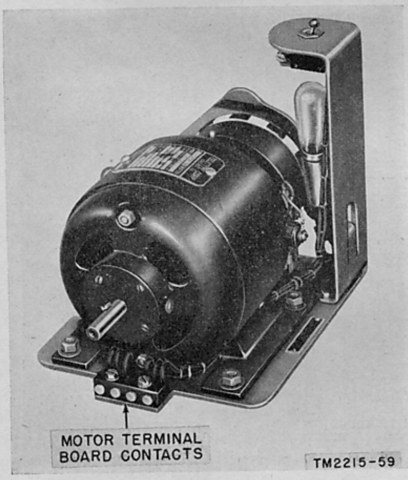


Figure 47. Motor contact terminal board.

the Rec-29 disconnects both sides of the input line from the entire rectifier with the *exception of this panel.*

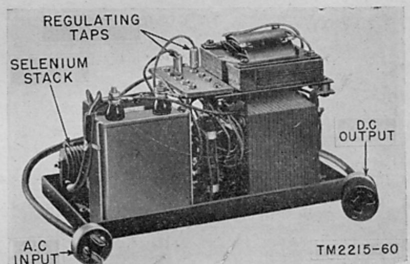


Figure 48. Rec-10 rectifier taps.

(5) Be sure that all power cords are in good condition.

Caution: Do not make any adjustments while the rectifier is in operation.

(6) Adjustments (figs. 48 through 51) of voltage and frequency are arranged as follows:

(*a*) To arrange for a-c input voltage (Rec-29 only), connect the flexible lead on the left-hand side of the panel to the terminal with the marking which most nearly corresponds to the voltage of the available a-c supply.

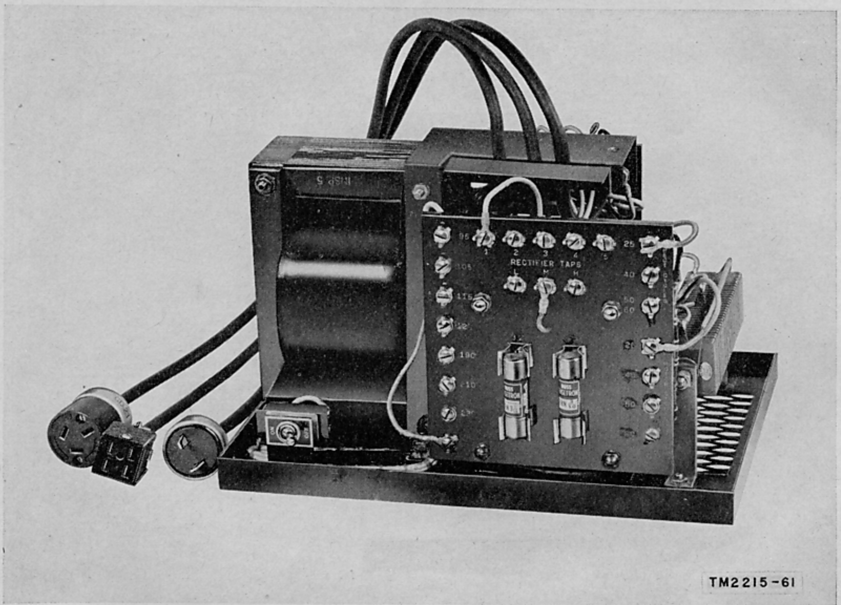


Figure 49. Rec-29 rectifier taps.

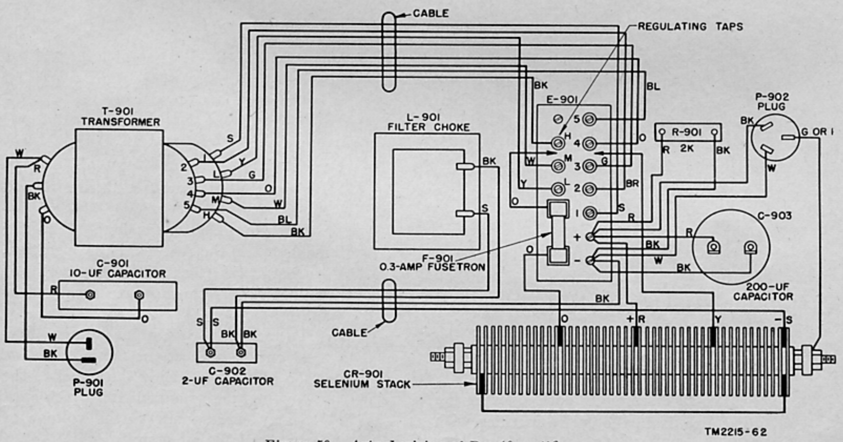


Figure 50. Actual wiring of Rec-10 rectifier.

(*b*) To arrange for frequency (Rec-29 only), connect the two flexible leads on the right-hand side of the control panel to the two terminals (RECT CYCLES and MOTOR CYCLES) which have markings that most nearly correspond to the frequency of the available a-c supply (figs. 49 and 51).

(*c*) To arrange the d-c output voltage of rectifiers Rec-10 and Rec-29, connect a 600-ohm resistor in series with a suitable milliammeter across the d-c output of the rectifier. Connect the flexible leads located near the top of the control panel to the terminals (marked L, M, H for coarse adjustment and 1, 2, 3, 4, 5, for fine adjustment) that cause the milliammeter to register a current flow which is nearest to but not less than 0.2 ampere. Check this arrangement when the rectifier is installed and periodically thereafter. Voltage drop due to initial aging of the rectifying assembly decreases with service. After the first few months of use, the rectifier should operate for long periods of time without the necessity for readjustment. If it becomes necessary to use the maximum regulation tap to obtain proper output current, withdraw the rectifier from service and repair it.

(7) Replace or close the cover on the rectifier power unit.

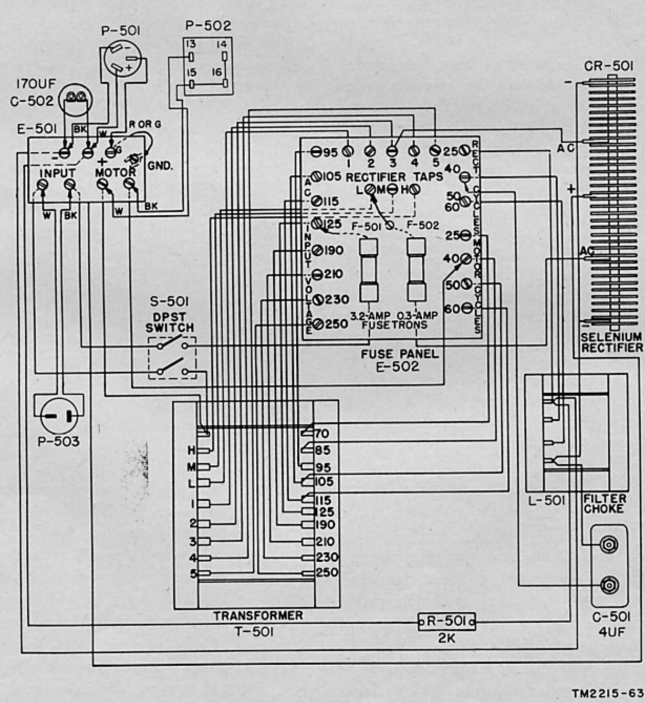


Figure 51. Actual wiring of Rec-29 rectifier.

(8) Set the rectifier power unit on its shelf in the table.

(9) Connect the ground lead to the table ground screw (fig. 55).

(10) Plug the three (two from Rec-10) power cords into their proper outlets in the electrical service assembly of the table (figs. 52, 53, and 55). Figure 54 shows a rear view of the electrical service assembly.

Caution: Never handle conductors with bare hands. Always use lineman's gloves. Treat every conductor as if it were alive. Be sure the power switch on the rectifier power unit is at OFF.

(11) Connect all power leads through the a-c section of the rectifier and the electrical service assembly of the table to the motor unit of the teletypewriter.

(12) Operate the power switch on the rectifier to ON.

(13) After the power has been turned on, start the motor unit by operating the motor switch (fig. 52) to ON. If there is excessive noise (probably caused by faulty meshing between motor pinion and main shaft gear), *immediately* operate the motor switch to OFF.

(14) If the equipment appears to run satisfactorily, let it run approximately 1 minute, then turn the power off. If there is any doubt as to the satisfactory operation of the equipment, or if it does not operate at all, turn off the power.

(15) Disconnect the power from the equipment and all operating components by placing the motor switch and the rectifier power unit switch at their OFF positions. This is preparatory to connecting the equipment to the signal circuits.

21. Connections to Line and Other Equipment

a. General (figs. 45, 55, and 56).

(1) After grounding and power arrangements are completed, connect the teletypewriters in the signal circuits in which they are to operate. Specific connection instructions are given below.

(2) Plug the receiving cord (terminated in a plug with a red shell) into the line jack marked RED in the jack block which faces the front under the table top. Figure 53 shows the electrical outlets and receptacles and the jack block by which a teletypewriter can be connected.

(3) Plug the sending cord (terminated in a plug with a black shell) into the line jack marked BLK in the jack block.

b. Line and Battery Connections (figs. 45 and 55). The terminal board in the electrical service assembly of the table facilitates connection of either a half-duplex or full-duplex signal line to the teletypewriter set. These connections may be made for full-metallic or ground-return loops. Also available are a sliding resistor (fig. 53) and two battery terminals through which rectifier battery may, if required, be supplied for one single loop. Battery for each line circuit for full-duplex operation should be supplied at the station which is transmitting.

Caution: Operate the teletypewriter motor switch to its OFF position and disconnect the rectifier.

(1) *Single loop with all line battery supplied to loop from external source* (figs. 45 and 55).

(*a*) If the signal line battery is supplied by a *full-metallic* loop, strap terminals Nos. 8 and 9 and then connect the positive wire of the loop to terminal No. 7 and the negative wire of the loop to terminal No. 10.

(*b*) If the loop is *ground return* and the wire of the loop is negative, connect terminal No. 7 to ground at terminal No. 3; strap terminals Nos. 8 and 9 and connect the negative loop wire to terminal No. 10. If external battery on this loop wire is positive, ground terminal No. 10 at terminal No. 3, strap terminals Nos. 8 and 9, and connect the positive loop wire to terminal No. 7.

(2) *Single loop with line battery supplied by rectifier* (figs. 45 and 56).

(*a*) If the rectifier of a teletypewriter set is to supply signal line battery to a full-metallic loop, strap terminals Nos. 8 and 11 (negative) and terminals Nos. 9 and 12 (positive), then connect the loop wires to terminals Nos. 7 and 10. If series-aiding external battery is supplied also by the loop, be sure that

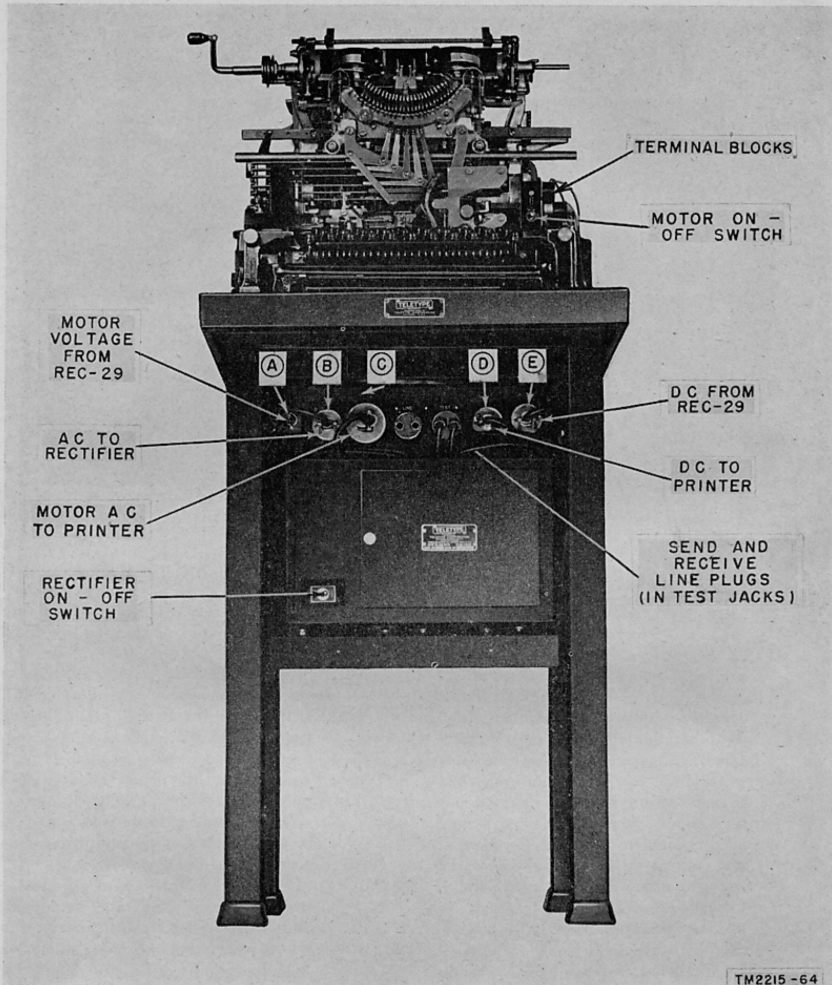


Figure 52. Table cord connections.

the negative loop wire is connected to terminal No. 10 and the positive loop wire is connected to terminal No. 7 (fig. 45). Similar results may be obtained by connecting as shown in figure 56. Series-aiding battery is used only on

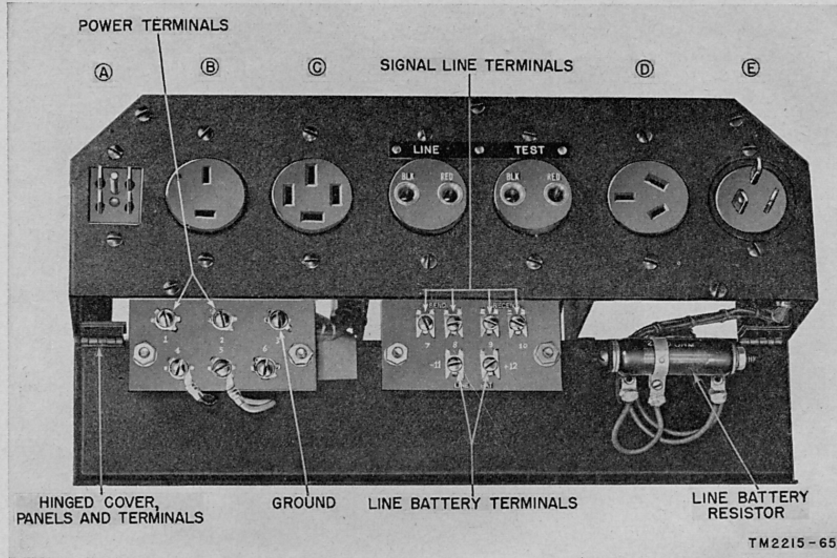


Figure 53. Electrical service assembly open, front view.

extremely long lines or to compensate for lines with excessive leakage.

(*b*) If the rectifier is to supply battery to a ground-return loop, strap terminals Nos. 8 and 9, strap terminal No. 12 (positive) and ground terminal No. 3, strap terminals Nos. 11 and 10 (negative), and connect the wire of the loop to terminal No. 7. If, however, there is series-aiding negative external battery on this wire of the loop, it must be connected to terminal No. 10 with the same strap between Nos. 8 and 9 but with the battery terminal No. 11 (negative) grounded to terminal No. 3, and terminal No. 12 (positive) straped to terminal No. 7. If desired, the same general results may be obtained by strapping terminals Nos. 8 and 11 and Nos. 9 and 12 instead of strapping Nos. 8 and 9. The loop wire then should be connected to No. 7 or No. 10, depending on polarity, and the remaining terminal (either No. 7 or No. 10) should be connected to ground terminal No. 3 (fig. 45).

(3) *Full-duplex with line battery supplied to loops from external source only* (fig. 45).

(*a*) If the signal line battery is supplied by two full-metallic loops (4 wires), connect the send loop to terminals Nos. 7 and 8 so that the negative loop wire is on terminal No. 8, and connect the receive loop to terminals Nos. 9 and 10 so that the negative loop wire is on terminal No. 10 (fig. 45).

(*b*) If ground return is required, the ground may be substituted for one of the wires of either or both pairs by connecting ground directly to terminal No. 3 and grounding those terminals for which ground is to replace the wire. For example, either terminal No. 7 or No. 8 of the send loop and/or terminal No. 9 or No. 10 of the receive loop can be connected to ground at terminal No.

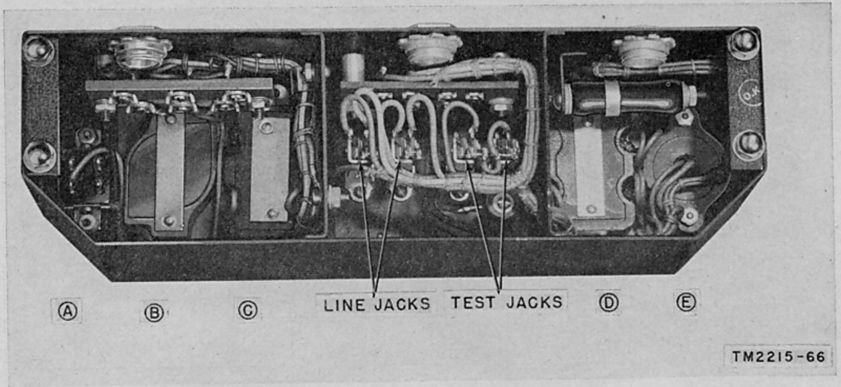


Figure 54. Electrical service assembly closed, rear view.

3, provided that equipment at the other end of the loop is connected similarly so as to completely replace any one wire of a pair with ground.

(4) *Full-duplex with line battery supplied by rectifier and loop.*

(*a*) If the rectifier of the teletypewriter set is to supply signal line battery to a full-metallic send loop, connect a loop wire to terminal No. 7 and the other wire to terminal No. 12. Strap terminals Nos. 11 and 8.

(*b*) If the rectifier is to supply signal line battery to a full-metallic receive loop, connect one loop wire to terminal No. 9 and the other wire to terminal No. 12. Strap terminals Nos. 10 and 11.

Note. The rectifier and single slide wire resistor are sufficient for supplying battery to only one of the loops. The other loop must be connected for external battery as described in (3) above. Refer to figure 45.

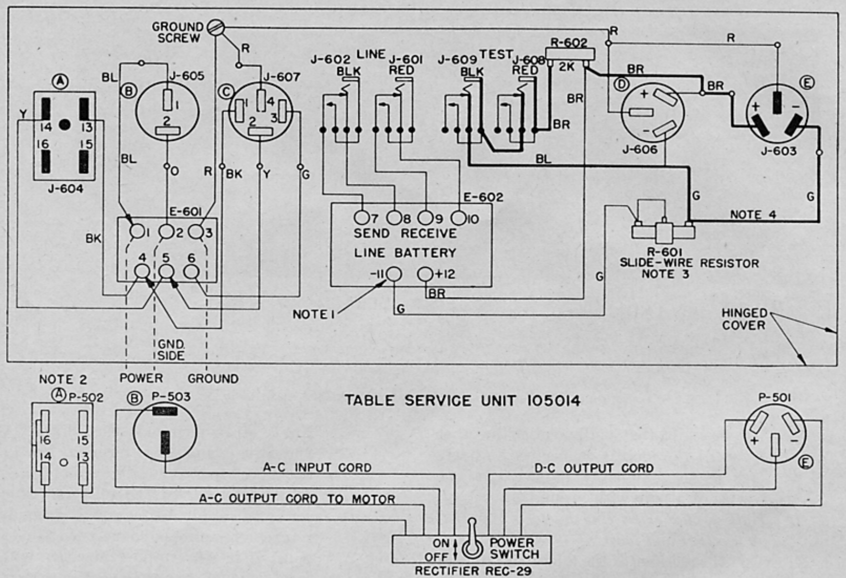
(*c*) If the rectifier of the teletypewriter set is to supply battery to a ground-return send loop, connect the loop wire to terminal No. 8, strap terminals Nos. 7 and 12 (positive), and strap terminal No. 11 (negative) to ground at terminal No. 3. If the wire of this loop has series-aiding positive battery from an external source, connect it to terminal No. 7, strap terminals Nos. 8 and 11 (negative), and strap terminal No. 12 (positive) to ground at terminal No. 3.

(*d*) If the rectifier of the teletypewriter set is to supply battery to a ground-return receive loop, connect the single wire; if it also supplies negative battery from an external source to terminal No. 10, strap terminals Nos. 9 and 12 (positive), and strap terminal No. 11 (negative) to ground at terminal No. 3. If this single wire supplies positive external battery, connect it to terminal No. 9, strap terminals Nos. 10 and 11 (negative), and strap terminal No. 12 (positive) to ground at terminal No. 3.

Note. Current must always flow through the line winding of the polar relay in the direction indicated in figure 45. A current direction for the send contacts is given as a convenient standard but does not appreciably affect their operation.

(5) *Connections to other equipment.*

(*a*) The teletypewriter sending and receiving circuits usually are connected to the associated equipment by placing the plug with the black shell in the send jack and the plug with the red shell in the receive jack of the table line relay, telegraph switchboard, carrier



NOTES:

1. LOOP BATTERY MAY BE SUPPLIED FROM TERMINALS 11 AND 12 IF REQUIRED.
2. CONNECTOR PLUGS AND TABLE SERVICE ASSEMBLY RECEPTACLES TO WHICH THEY CONNECT ARE DESIGNATED BY ENCIRCLED LETTERS.
3. ZERO TO 2500 OHM SLIDE-WIRE RESISTOR ADJUSTED TO 1700 OHMS AT FACTORY.
4. HEAVY LINE INDICATES LOCAL TEST CIRCUIT.

TM2215-67

Figure 55. Table service assembly and rectifier connections, schematic diagram.

telegraph terminal, or other equipment with which the teletypewriter is being used.

(*b*) To communicate, each transmitting component must be connected in series with at least one receiving component of a teletypewriter in the same circuit located at any station which is to receive communication. This is true whether the receiving teletypewriter is situated at the remote end of a signal line or whether the local transmitting component is connected to a local typing unit. If these teletypewriters are arranged to send to several other teletypewriter stations in the same signal circuit, all receiving components in the same circuit must be in series with the local transmitting contacts. To arrange the equipment for various methods of operation, make the necessary wiring changes at the line terminal board terminals marked Nos. 7 to 12, inclusive, at the table (fig. 45).

c. Wiring Diagrams. Figures 45 and 56 and the actual wiring diagram of the table (fig. 55) show how the equipment is arranged for operation. The explanation is as follows:

(1) The typing unit is connected for independent operation in a receive loop and the keyboard transmitting unit is connected for independent operation in a send line (fig. 45).

(2) The transmitting unit and the typing

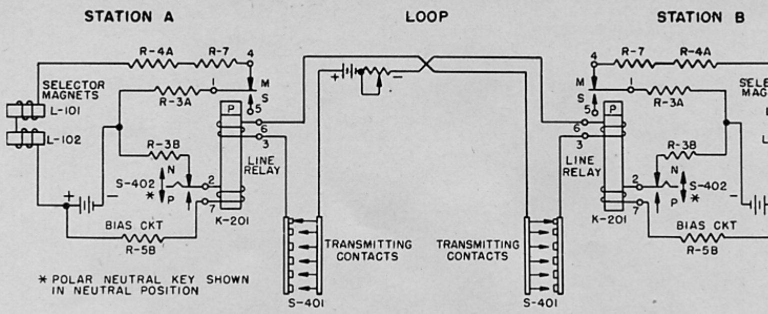


Figure 56. Interconnected teletypewriters (polar-neutral key in neutral position), simplified schematic.

unit are connected together in series in a send and receive loop (fig. 56).

d. Control Relay. To connect the control relay into the motor circuit for remote manual control, refer to figure 283.

22. Operating Checks and Adjustments

a. General. With the equipment connected to power and signal lines, and after ribbon and paper have been installed as directed, check the following:

(1) Speed of the motor units. Figure 57 indicates motor speed adjustment points.

(2) Rangefinder adjustment.

(3) Operation of each item of equipment.

b. Checking and Adjusting Motor Speed (figs. 57 and 58). When it is necessary to adjust Teletypewriters TT-5/FG and TT-6/FG to interoperate with British equipment, refer to appendix III and TM 11-486. The series-governed motors used with Teletypewriters TT-5/FG and TT-6/FG must rotate the main shaft of the typing units at the same speed as that of every other teletypewriter in the same circuit. Check the motor speed with the speed indicator (tuning fork). Proceed as follows:

(1) Remove the typing unit cover.

(2) Turn on the target lamp (fig. 58). The target is a series of alternate black and white segments painted on the rim of the governor.

(3) Turn on the typing unit motor. Let it run from 3 to 5 minutes before attempting speed adjustment. Always adjust motor speed under normal load conditions. To provide this load, hold the space bar down, while adjusting the motor speed. If desired, the teletypewriter may be plugged into the test jacks and checked in the artificial line provided through these jacks.

(4) Strike the speed indicator against the hand. Observe the target of the motor unit through the slots in the plate attached to the ends of each tine of the speed indicator. Figure 58 shows how to look through the vibrating aperture of the tuning fork when scanning the target. The correct speed adjustment is obtained when the white segments appear stationary. When the white segments seem to move backward, the speed is too slow. If the segments seem to move forward, the speed is too great. If the segments appear to jump back and forth or disappear suddenly, governor trouble is indicated. Practicable speed adjustment is reached when the white segments of the target appear to be just barely moving in the direction of rotation of the motor.

(5) If the speed is too great, momentarily press, and then release, the governor-adjusting *bracket* (fig. 58).

(6) If the speed is too slow, momentarily press, and then release, the governor-adjusting *lever* (fig. 58).

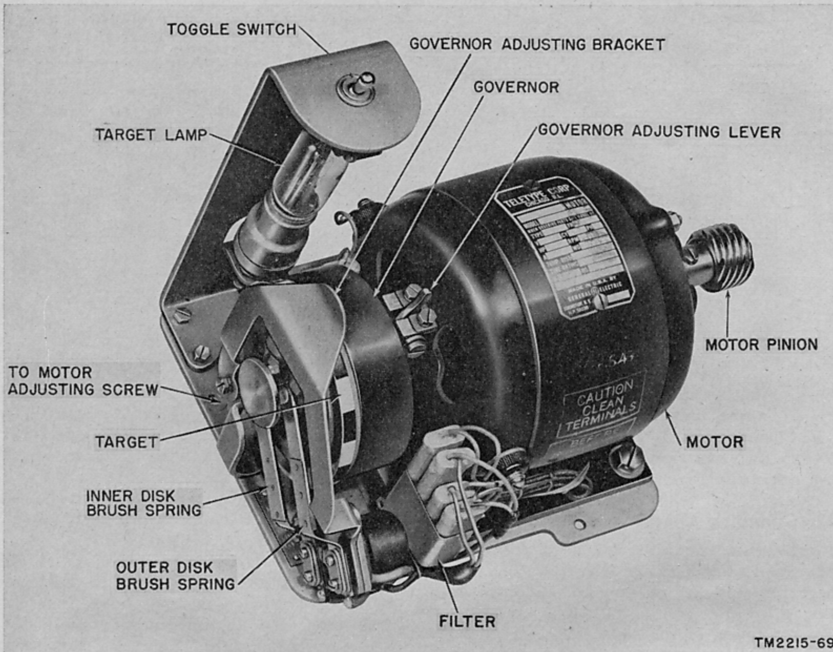


Figure 57. Motor governor adjusting parts.

(7) The final setting may be made by stopping the motor and regulating the governor-adjusting wheel manually.

(8) After the proper speed has been obtained, turn off the target lamp and restore the typing unit cover.

c. ALTERNATE METHOD OF CHECKING MOTOR SPEED. If the proper speed indicator (included in Tool Equipment TE–50 or TE–50–A) is not available, check and adjust the motor speed by the timing method outlined below:

(1) Remove the typing unit cover; operate the motor ON-OFF switch to ON.

(2) Operate the CAR RET and LINE FEED keys of the keyboard.

(3) Print the numbers 1 through 0 in groups of 10 characters across the entire page to make sure that the equipment is operating properly.

(4) Operate the CAR RET and LINE FEED keys again.

(5) Press the space bar (fig. 59). Hold it down for 10 seconds. Time this interval accurately with a watch. At the end of 10 seconds, release the space bar and operate any numeral key.

(6) Count the number of spaces traveled by the type-bar carriage during the 10-second interval. The correct number of spaces traveled for proper adjustment is 61. If the number of spaces traveled is more or less than that number, adjust the governor as follows:

(*a*) If the number of spaces is greater, decrease the motor speed.

(*b*) If the number of spaces is less, increase the speed.

(7) Restore the typing unit cover.

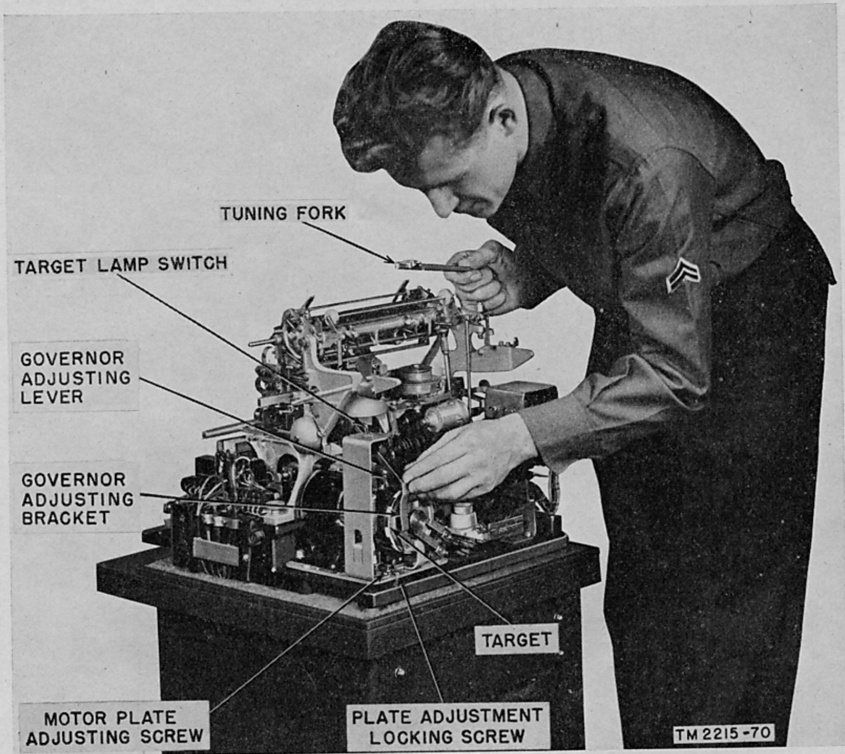


Figure 58. Checking and adjusting motor speed with target and tuning fork.

d. Rechecking Motor Speed. Make a quick recheck of the motor speed on a teletypewriter known to be otherwise properly adjusted, as follows:

(1) Allow the motor to warm up from 3 to 5 minutes.

(2) Press the CAR RET key to return the type-bar carriage to its returned (extreme left) position.

(3) Check the time that elapses after the space bar is pressed until the margin bell rings. (The carriage should move 61 spaces in 10 seconds when adjusted for approximately a 61-wpm speed.)

(4) If the motor speed and the margin bell are properly adjusted, then the margin bell will ring at the end of 11 seconds on Teletypewriter TT–5/FG. For Teletypewriter TT–6/FG the correct time interval is nearly 12 seconds. Refer to *b* and *c* above if adjustment of motor speed must be made.

e. Setting Rangefinder. The rangefinder (fig. 60) can be used to adjust a teletypewriter to compensate for distortion in incoming signals and also to check the operation of a teletypewriter against signals known to be acceptable. Distortion in teletypewriter circuits is discussed in TM 11–486

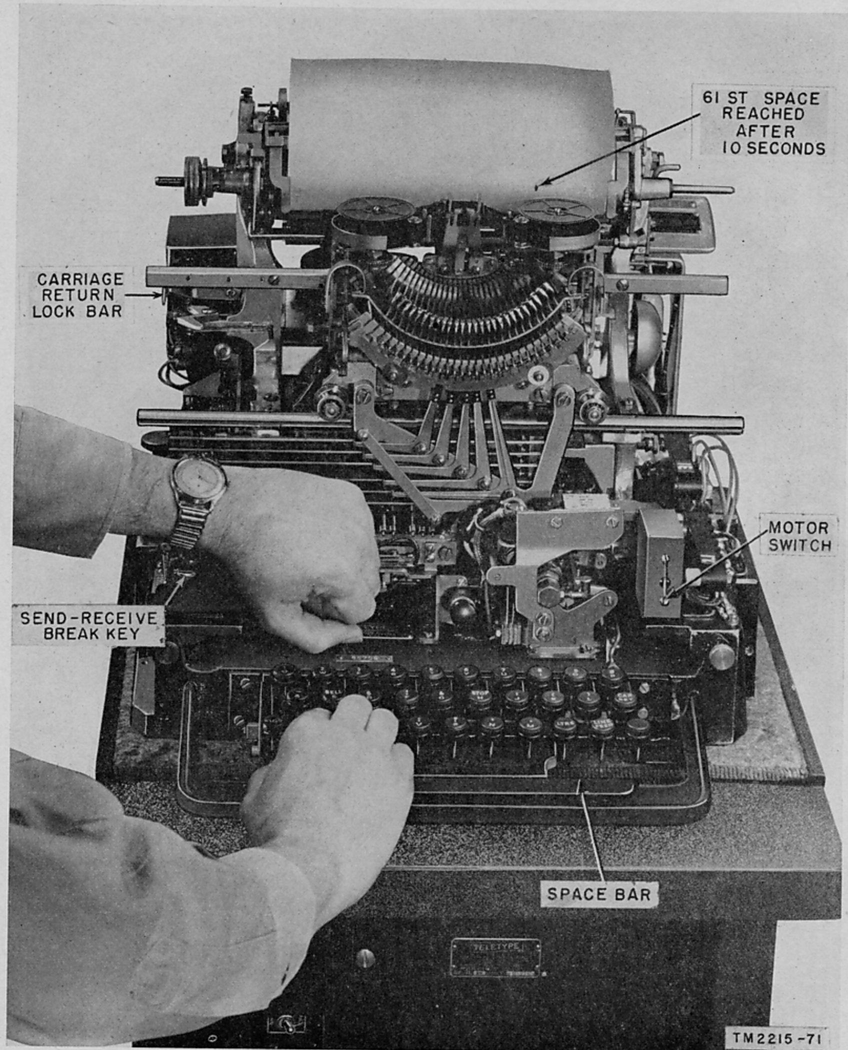


Figure 59. Checking motor speed by timing method.

and TM 11-680. The procedure in using this rangefinder for both purposes is similar. To use the rangefinder to check the operations of a teletypewriter using a normal signal, proceed as follows:

(1) Arrange for a series of R and Y signals to be sent to the equipment being adjusted. R and Y signals are used because in sending them the impulses are utilized in an alternating manner. By plugging a test unit into the test jack marked BLK a local transmitter or transmitter-distributor sending from perforated tape can be used for this purpose, if the red plug of the teletypewriter to be tested is plugged into the receive jack marked RED in the test circuit of the table.

(2) Loosen the index-arm thumbscrew of the rangefinder mechanism (fig. 60).

(3) Move the index arm toward the zero end of the scale until errors appear in the typed matter which is being received on the typing unit.

(4) Slowly move the index arm back until the errors disappear. At this point, note the low limit reading of the rangefinder scale.

(5) Slowly move the arm back toward the high end of the scale until errors are noted.

(6) Slowly move the index arm back toward the low end of the scale until the errors disappear. Then note the high limit reading on the rangefinder scale.

Note. An acceptable range for a teletypewriter in good condition is: low—1–15; high—85–90.

(7) To find the scale reading for the point of best operation for the teletypewriter, take the average of the readings, noted in (4) and (6) above (high plus low divided by 2).

(8) Set the index arm to the computed scale reading and tighten the thumbscrew securely.

23. Local Operating Tests

a. General. In giving the test procedure below it is assumed that all connections, fuses, etc., have been completed and installed, that a visual examination has been made to see that the equipment has been properly lubricated (par. 43), and that no damage to parts is evident. Detailed instructions for line-up procedure are covered in paragraph 24. Complete the tests in the order given below.

b. Operating Tests.

(1) Remove the typing unit cover.

(2) Operate the Rec-29 rectifier a-c switch (fig. 59) to ON. Plug in Rec-10, if used.

(3) Operate the motor switch (fig. 59) to ON.

(4) Plug the red and black teletypewriter plugs into their respective test jacks in the electrical service assembly of the table (fig. 52).

(5) Lift the SEND REC BREAK key up (fig. 60) to SEND. Operate the polar-neutral key to neutral (pulled-out position).

(6) Turn the platen crank (fig. 60). See that the paper feeds evenly and does not tear.

(7) Adjust the rangefinder as instructed in paragraph 22*e*.

(8) Check the line current of the test circuit for 60 ma. Use a milliammeter.

(9) Type at least three consecutive copies of the following test paragraph—THE (space) QUICK (space) BROWN (space) FOX (space) JUMPED (space) OVER (space) THE (space) LAZY (space) DOG (FIGS) ' (LTRS) S (space) BACK (space) (FIGS) 1234567890 (LTRS) (CAR RET) (CAR RET) (LINE FEED)—followed by all the remaining upper case characters remaining on the keyboard.

(10) While the test paragraph is being typed, observe the ribbon-feed mechanism to see that it oscillates and feeds each time a character is typed.

(11) Hold down the space bar to see that spaces are continuously transmitted while the space bar is held operated.

(12) Operate the carriage-return lock bar (fig. 59 or 60) to see that the type-bar carriage can be returned manually.

(13) Test the setting of the margin warning bell by pressing CAR RET, LINE FEED, FIGS followed by 1234567890 repeat until the margin bell rings. Count the number of characters per line to the

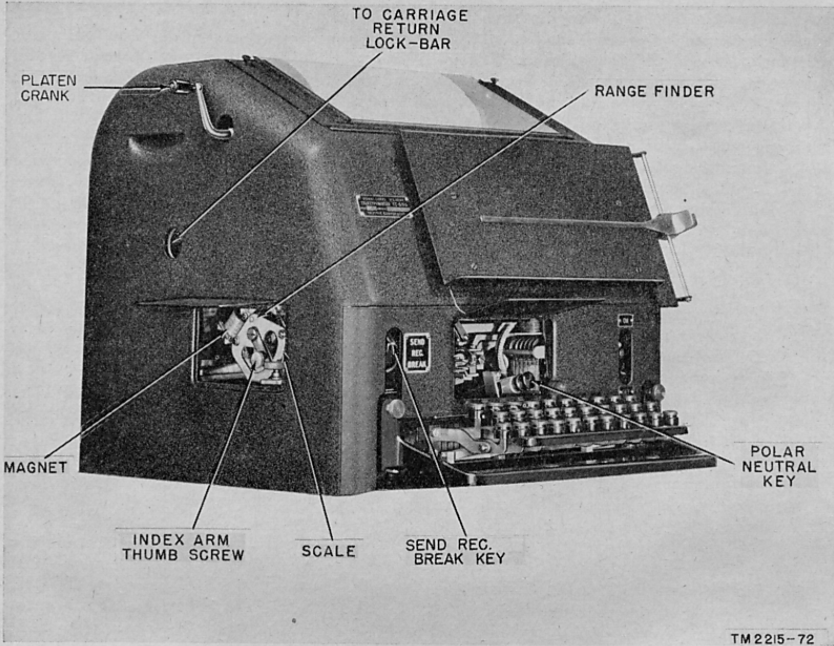


Figure 60. Rangefinder and polar-neutral key mechanisms.

point when the bell rings. On Teletypewriter TT–5/FG the correct character count per line is 66, and on Teletypewriter TT–6/FG the count is 70. (These bell settings are for 72- and 76-character lines, respectively.)

(14) On Teletypewriter TT–5/FG *only*, test the remote motor control feature by pressing CAR RET, LINE FEED, FIGS, and STOP (upper case H).

Note. On Teletypewriter TT–6/FG a symbol necessary to weather communication is transmitted from the FIGS H position.

(15) Press FIGS, BELL (upper case S) to test operation of the signal bell.

(16) Test the remote control start feature by holding the SEND REC BREAK key (in its lower position) at BREAK for 2 to 3 seconds.

(17) Be sure that the sending mechanism cannot send when the SEND REC BREAK key is at the middle or REC position.

(18) With the SEND REC BREAK key at its upper or SEND position, press the blank key twice in succession.

Note. On Teletypewriter TT–5/FG this function should automatically move the SEND REC BREAK key to REC position. On Teletypewriter TT–6/FG operation of the blank key from the FIGS position of the teletypewriter results in the transmission of a dash. The blank function operates on this teletypewriter from the LTRS position of the machine only.

(19) Set the SEND REC BREAK key at SEND. Transmit one blank combination alternately with some other letter or character of the keyboard. This should

not result in moving the key from SEND to REC, as in (18) and the note above.

(20) Restore the typing unit cover and test the opening and closing of all hinged doors and covers. Try the cutting edge of the glass window by tearing off paper as is done when typed messages are torn off during actual operation.

(21) When tape perforators, reperforators, and transmitters are used in conjunction with or in the same loop with a model 15 teletypewriter, the remote motor control combination (FIG H or STOP on TT–5/FG only) should not be perforated in tape unless it is the last combination to be perforated in the tape. The start (spacing) impulse of any succeeding combination, including H, sent by a transmitter-distributor from the tape will merely start the motors again. This causes a momentary fluctuation in motor speed which results in loss of synchronism between transmitting and receiving equipments. Teletypewriter TT–6/FG, in common with other weather communication teletypewriters, does not have the *remote motor stop* feature, as an important weather symbol is transmitted from the upper case, or FIGS H position.

Note. On Teletypewriter TT–5/FG the CAR RET and LINE FEED keys can be operated from either the FIGS or LTRS position. On Teletypewriter TT–6/FG these functions operate from the LTRS position *only*.

24. Line-up Procedure

a. General. Line-up procedure for teletypewriter circuits includes arranging for supply of line current and adjusting the line current. The connections that must be completed at the table of Teletypewriters TT–5/FG and TT–6/FG to supply line current and power with instructions for adjustment are contained in paragraphs 20 and 21.

(1) When a teletypewriter circuit terminates at a switchboard, circuit line-up is directed by the switchboard operator who usually has facilities, such as a milliammeter, readily available for quick checking and adjusting. Similarly, most telegraph carrier terminal stations will also have men available to switch or plug measuring instruments into a circuit and to make adjustments without seriously disrupting service. Line-up of a circuit between two stations is directed by the station operator at the higher headquarters. Line-up of a circuit between two stations of equal authority is directed by the station having the lower numerical designation.

(2) Operators at both the control and noncontrol stations can usually communicate by telephone prepartory to lining up a circuit. When they cannot, communication can be carried on by a system of break signals. Break signals can be observed on a meter such as that of a line unit used with field equipment and on the meter of a switchboard. The following system of break signals can be used to avoid confusion when lining up a circuit:

(*a*) One 3-second break means: "Stop transmission. I am through with my adjustment and will send repeated space-bar signals."

(*b*) Two 3-second break signals sent by a control station mean: "Arrange to supply line current."

(*c*) Three 3-second break signals mean that further line current adjustment is necessary and that the local operator should send repeated space-bar signals.

b. Supplying Line Current. It is sometimes necessary for both terminals to supply line (loop) current. When only one station supplies loop current, the operator at the control station will usually make the necessary loop current adjustments.

(1) On the teletypewriter base, back of the typing unit, are two slide contact type mountings each of which contains a flat type of line pad resistor that may be connected in the signal line circuit if necessary. These resistors have three terminal prongs and are tapped (off center) to provide a choice of three different resistances for each resistor unit. The 600-ohm unit may be strapped to provide either 200 or 400 ohms and the 800-ohm unit may be strapped to provide either

300 or 500 ohms. The top slide mounting is connected to terminals Nos. 69 and 70 which in turn are connected to terminals Nos. 33 and 34. The bottom resistor mounting is connected to terminals Nos. 68 and 67, which in turn are connected to terminals Nos. 35 and 36. Refer to the wiring diagram (fig. 283).

Example: 400 ohms are required in the send loop and the 600-ohm resistor is in the top slide mounting. Disconnect the loop wire from terminal No. 34 and reconnect it to terminal No. 33, thereby inserting 600 ohms; then strap (short) the 200-ohm section of the 600-ohm unit to provide 400 ohms in the send loop circuit, or in both the send and receive loops if they are in series.

(2) If both resistors are required, terminal No. 33 may be strapped to No. 36 and the loop wire moved from No. 34 to No. 35.

c. Completing Circuit Line-Up.

(1) Send repeated space signals when requested.

(2) When a 3-second break signal is received from the control station, stop sending space signals. If the control station requires further space signals to complete an adjustment, three 3-second signals will be received. When the control station has completed the necessary adjustments, the operator at that station will send a test message. If accurate copy is received, the line-up procedure is completed correctly. The operator at the local station then sends a test message. Acknowledgment from the control station that the test message is received correctly will complete the line-up procedure and indicate that the circuit is ready to handle traffic.

(3) If correct test copy is not received, the Ry-30 line relay may be tested and adjusted in accordance with paragraph 414. Commonly the cause of line failure is a poor line connection due to bad splices, damaged insulation, or poor ground connection. If line trouble is suspected, refer to the local maintenance activity for corrective measures.

25. Procedure for Removing Equipment From Service

a. General. Teletypewriters TT–5/FG and TT–6/FG can operate on several circuits, simultaneously. Therefore, the stations in each circuit must be notified when operation is to be discontinued or interrupted. If only one operating component is removed, only the stations in the circuit concerned need be notified. The procedure given below applies when either the entire equipment or a single operating component is removed from service.

b. Step-by-Step Procedure.

(1) Notify the distant station or net that the local station (or one of the components) is to be removed from service. The proper operating procedure normally is directed by current Department of the Army directives and local SOI (signal operating instructions) or SOP (standing operating procedure).

(2) If the station is connected to a switchboard, notify the switchboard operator, and then remove the equipment from the line.

(3) If the station is connected to a field teletypewriter that uses a line unit, instruct the operator at the field station to adjust line current accordingly.

26. Operating Features

a. General. The keyboard of a teletypewriter is essentially similar to the keyboard of a conventional typewriter. However, the following differences are to be noted: The keyboard of a typewriter has four rows of keys, whereas a model 15 teletypewriter keyboard has only three rows of keys. On a typewriter the type basket is stationary, and the platen travels from right to left during the typing process. On a teletypewriter the platen is held stationary, but the type basket travels from left to right. The nontyping functions of a typewriter, such as the return of the platen for starting a new line, the shift operations, and the paper feed, are direct manual operations. On the teletypewriter these functions are performed electromechanically by pressing keys on the keyboard. The typewriter can print either lower case or upper case letters, whereas the model 15 teletypewriter prints only capitals. The speed

at which a typewriter can be operated can vary considerably, depending upon the skill of the operator, whereas the teletypewriter is designed to operate at a predetermined regular rate. Teletypewriters TT–5/FG and TT–6/FG, when transmitting into a line, must be operated with a uniform rhythm to prevent omission errors in copy due to speed in excess of that for which the teletypewriter is adjusted. This requirement is not critical when perforating tape with a keyboard perforator, but it is good practice to maintain a uniform rhythm at all times. The operating features of Teletypewriters TT–5/FG and TT–6/FG are detailed in *b* below.

b. Function Keys. The keys which are used to perform the nonprinting functions of these teletypewriters are:

(1) *Space bar.* This bar, located at the bottom of the keyboard (fig. 61), is used to send spaces (as between words). It will send spaces as long as it is held down.

(2) *CAR RET—(carriage return).* Pressing this key returns the type basket to the left to start a new line of typing.

(3) *LINE FEED.* This key is pressed to feed the paper upward one or two spaces, as adjusted, to present a clean surface upon which to start the next line.

(4) *FIGS—(figures).* This key shifts the machine to print numerals, punctuation marks, or symbols.

(5) *LTRS—(letters).* This key is used to restore the machine from the FIGS position in order to print letters again.

(6) *BELL—(FIGS S).* Operating this key (which is the upper case position of the S key), after pressing the FIGS key, will ring a signal bell locally and at the distant stations. Do not confuse this bell with the margin warning bell.

(7) *STOP—(FIGS H).* On Teletypewriter TT–5/FG, pressing this key (remote motor stop feature) will stop the motor units of all equipments in the circuit. On Teletypewriter TT–6/FG, key FIGS H prints a symbol required in weather communication.

(8) *Blank key.* On Teletypewriter TT–5/FG, pressing this key twice, when the SEND REC BREAK key is at SEND, will move the break mechanism to REC. On Teletypewriter TT–6/FG, operating the blank key results in typing a dash (—).

c. Margin Adjustment. The left and right margins of the teletypewriters are adjusted as directed in paragraphs 369 and 370. The operator is not authorized to make these adjustments.

27. Operating Precautions

a. General. Teletypewriters are adjusted to operate at a predetermined speed. Therefore, the operator must develop touch, speed, and regularity so that errors will be avoided while maintaining the maximum allowable speed. Operation of the keyboard during transmission is the same whether a reperforator-transmitter or reperforator in the line is perforating tape or not. Hold the fingers of the hands over the keys as shown in figures 1 and 62. Hold the thumbs just above the space bar.

(1) *Touch.* Strike the keys lightly. Striking them too hard may result in errors.

(2) *Speed.* The normal speed of a teletypewriter is approximately 61 wpm. When operating in circuits connected to British teletypewriter equipment, the speed is increased to about 66 wpm (app. III). Attempting to operate the keyboard more rapidly than normal will result in errors and will not increase the speed of transmission.

(3) *Rhythm.* Do not strike any key before the code signal of the key previously struck has been transmitted. Avoid the tendency to send frequently used words such as *at*, *the*, *that*, etc., more rapidly than other combinations. A steady, deliberate operating rhythm results in fewer errors and dropped-out characters.

b. Characters per Line. The margin warning bell rings six characters before the end of a line. Be careful not to overtype the last character. The margin warning bell rings on the 66th printed character for lines of 72-character length and on the 70th for lines of 76-character length. For the bell to ring on Teletypewriter TT–5/FG, the character count should reach 66. For Teletypewriter TT–6/FG this character count should be 70.

c. Carriage Return and Line Feed. To begin a line at the left margin of the paper, strike the CAR RET key, and then operate the LINE FEED key to move the paper up one line. On Teletype-

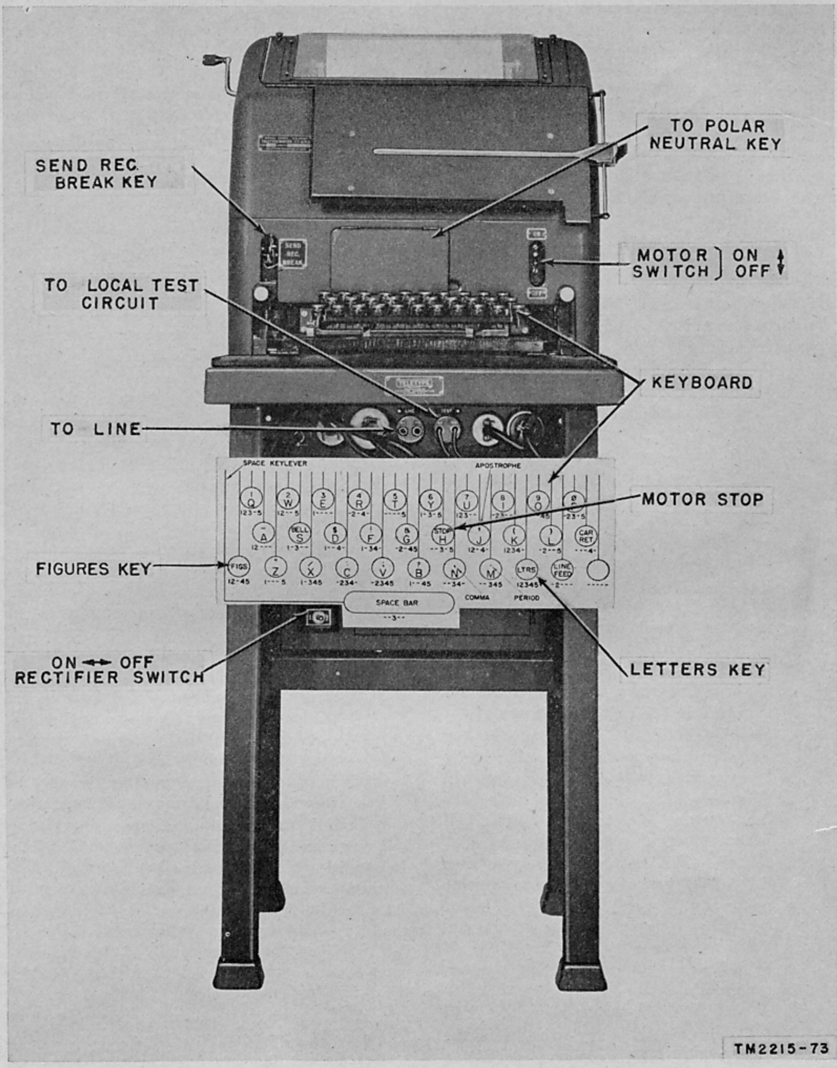


Figure 61. Teletypewriter set arranged for operating test.

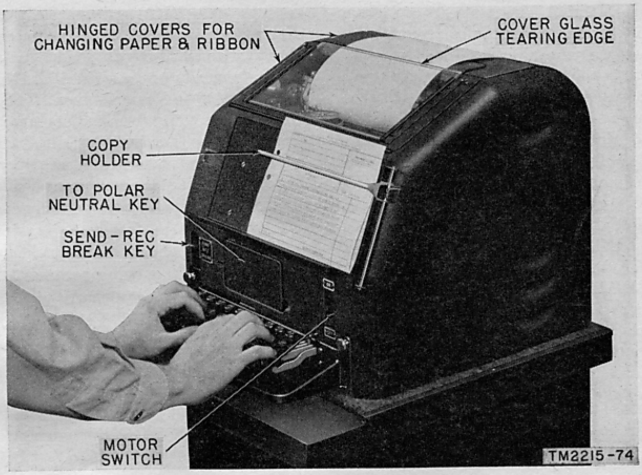


Figure 62. Operator's hands in typing position.

writer TT–6/FG, CAR RET and LINE FEED will operate only in the LTRS (or lower case) position. It is good practice to press the CAR RET key twice (this function is the most critical as to speed) to reduce possibility of error.

d. PAPER AND RIBBON.

(1) *Paper.* The roll of paper is installed in the machine as described in paragraph 14*b*. The paper is fed up and over the platen, and out of the machine through a slot formed by the edge of the glass window and the hinged cover at the top of teletypewriter (fig. 62). The paper can be torn off against the edge of the glass window after each message. Various types of paper may be used, including rolls, that will furnish one or more carbon copies. The type and kind depend upon the local requirements.

(2) *Ribbon.* The ribbon of a teletypewriter oscillates vertically and is transported laterally with each printing operation.

28. Teletypewriter Operator

The teletypewriter operator must handle traffic as prescribed in Department of the Army directives and local SOI (signal operating instructions) and SOP (standing operating procedure). He must get the message through, observe security regulations at all times, use the equipment to transmit official traffic only, and perform only those maintenance and adjustment procedures that are within his authority.

29. Starting Procedure

a. APPLYING POWER. See that the a-c input cord to the rectifier power unit is firmly plugged into the receptacle (B, fig. 52). Operate the switch on the rectifier power unit (fig. 61) to ON.

b. SELECTING TYPE OF OPERATION. Teletypewriters TT–5/FG and TT–6/FG always *send* neutral type signals. However, they can be adjusted to *receive* either neutral or polar type signals (par. 111).

(1) *Neutral.* To receive neutral type signals, pull out the polar-neutral key (figs. 60 and 62).

(2) *Polar.* To receive polar type signals, push in the polar-neutral key. To transmit on a polar or polarential circuit, connect Teletypewriters TT–5/FG and TT–6/FG to the line through a terminal repeater or other type of pole-changing equipment, (par. 9*c*).

c. LINE TEST JACKS. The two pairs of jacks in the jack block of the table service assembly can connect the equipment to either the line circuit or to the local test circuit. To connect the equipment to either of the two circuits to which these jacks are connected (fig. 61), plug the two teletypewriter cords into the pair of jacks desired (line or test). In either case, plug the send cord (black-shelled plug) into the jack marked BLK and the receive cord (red-shelled plug) into the jack marked RED.

d. SEND REC BREAK KEY. Move the SEND REC BREAK key (fig. 62) to BREAK. Press the key to BREAK for approximately 2 to 3 seconds. This starts the motors of all teletypewriters in the same circuit if they were previously stopped by remote control and if their motor switches are in ON position. To receive, move the key to REC. This bypasses the transmitting contacts, preventing accidental interruption, and the machine will then print from line signals only. To transmit, move the key to SEND. The teletypewriter can send or receive with the key at this position. This key also can be reset to the REC position by operating the blank key twice in succession, or by opening the line for a time interval equal to 2 revolutions of the transmitting cam shaft (par. 110).

30. Operating Teletypewriter

a. GENERAL. Arrange the equipment for the type and method of operation desired (par. 9*a*). Operation of the teletypewriter consists of setting switches and operating keys and in making the necessary adjustments of signal line characteristics. The information given below outlines, generally, the operation of these teletypewriters.

b. KEYBOARD. Set the polar-neutral key to the appropriate position. Strike the keys with firm, evenly spaced strokes. To start a new line, press LTRS, *CAR RET*, *CAR RET*, and LINE FEED keys in succession. (Note that the CAR RET key is pressed twice.) Press the space bar to insert spaces between words or word groups. The space bar will send repeated spaces as long as it is held down. To send letters, press the LTRS key and then the keys for the desired letters. To send figures, punctuation marks, weather symbols, and other characters or functions marked on the keytops, press the FIGS key and then the keys for the desired characters. After the message is sent, check the finished copy. If it is desired to signal the distant operator, use the BELL key (fig. 61).

c. OPERATOR'S MAINTENANCE. The authority of the operator to perform maintenance functions is limited. The functions performed are usually the replacement of supplies, such as paper and ribbon, the observation of the equipment during operation, and making certain routine maintenance checks. The equipment performance checklist (par. 33) enables the operator to determine whether the equipment is functioning properly.

31. Stopping Procedure

a. Notify stations in the circuit that operation is to be interrupted or discontinued.

b. Follow local SOI and SOP and current directives for operating procedure.

c. Operate all ON-OFF switches to their OFF positions (fig. 61).

32. Purpose and Use of Equipment Performance Checklist

The equipment performance checklist (par. 33) helps the operator determine whether these teletypewriters and/or their associated circuits are functioning properly. The checklist gives in five columns order of checking, items to be checked, the action or condition under which checks are made, normal results of these checks indicating correct operation, and corrective measures for the operator to take if operation is not correct.

a. ITEM. This column lists the parts or units to be checked.

b. ACTION OR CONDITION. This column of the checklist gives the settings of various switches and controls or the action to be taken to check operation of the equipment for each item listed in the first column.

c. NORMAL INDICATIONS. This list includes the audible and visible signs that the operator should obtain for each action or condition listed in *b* above. If not obtained, refer to the column headed Corrective measures. No meter readings are given because normally the equipment does not have a meter.

d. CORRECTIVE MEASURES. The corrective mea-

sures instructions are those that the operator is authorized to apply. When he does not understand instructions, the case should be referred to an experienced mechanic. When the measure or series of measures listed for a trouble do not apply or clear that trouble it means that the repairs must be made only by an experienced teletypewriter mechanic. If these checks indicate line or cable trouble rather than teletypewriter trouble, refer the case to the wire chief or to the maintenance authority which the commanding officer may direct.

33. Equipment Performance Checklist for Teletypewriters TT–5/FG and TT–6/FG

Note. Check the items in the preparatory section of this list in the order given. The items are arranged in the sequence in which these operations are performed during installation of the equipment.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
P R E P A R A T O R Y	1	Ground	Check connections at teletypewriter table ground screw terminals. ***Caution:*** Be sure that all power switches are in OFF position while checking connections.	No resistance or voltage (shock potential) between teletypewriter table and ground. Grounded loops carry current (pull up selector magnet armature) when battery is applied to proper end of line.	Refer to paragraph 19 and figure 53 or refer to chapter 4. (Electrical connections covered in paragraph 21.)
	2	Power unit: a-c frequency and voltage selector taps.	Set to match power source. Be sure that terminal screws are tightened securely. Power switch ON.	Motor and target lamp operate when their switches are at ON.	Check for good fuses of correct value. Check cords and connections.
	3	Power unit: rectifier transformer taps and and all cords for table and power unit.	Have been previously set for correct d-c output by teletypewriter mechanic with meter. All power and line cords are plugged in or properly connected. Switches ON.	Steady line current of correct value permitting normal operation and good copy.	Check to verify with switchboard operator or someone with meter in circuit.
	4	Line terminal block in electrical service assembly of table.	Signal line conductors connected to proper terminals for method of operation to be conducted. Correct polarity of battery, or ground, or grounded battery connected to proper terminals on block. Correct resistance in line.	Teletypewriters run closed on steady marking current when not sending or receiving. Switchboard or terminal equipment obtains correct meter readings.	Check with terminal or switchboard operator. *Note.* If the line is open or out of service, the teletypewriter may be tested by plugging the red- and black-shelled plugs into their test jacks in the table.
	5	Typing unit	*a.* Paper and ribbon properly installed and operating. *b.* Copyholder installed. *c.* Motor switch at OFF.	Visible	Refer to paragraph 14.
	6	Table	Table grounded. Teletypewriter centered on pad on top of table. All plugs in proper receptacles and jacks. Rectifier centered on shelf in front part of table.	Current available to motor, line, and terminal block.	Refer to chapter 1, section III.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	7	Typing unit and keyboard.	Power connected with all switches at ON.	With motor running, teletypewriter runs closed (quiet) on closed line or when plugged in test jacks.	Check and clean transmitter contacts (especially marking contacts), SEND REC BREAK contacts, keyboard shunt contacts, line cords and plugs, and pressure contacts between typing unit and the base and keyboard.
START	8	Motor switch	With rectifier power unit switch at ON, place typing unit motor switch to ON.	Unless previously stopped by remote motor control, the motor should start.	Refer to item 9 below.
	9	SEND REC BREAK key.	With switches the same as in item 8 above, operate the key to BREAK for 2 to 3 seconds. (Both key-levers must be held down).	Motor unit should be running or should start when line is closed again by releasing key.	Check all cords and connections. Check spring pressure contacts at front part of motor base. Check fuses.
EQUIPMENT PERFORMANCE	10	Typing unit and keyboard.	All switches at ON—press several keys (one at a time) for test. (Equipment has been adjusted and lined up as directed in paragraphs 22, 23, and 24.)	Teletypewriter runs closed (quiet) on steady marking current when not sending or receiving. Receives good copy when remote station sends, and also receives good copy from own sending if half-duplex.	Insert teletypewriter send and receive plugs in test jacks of table (red in RED and black in BLK as marked) and check range. If still bad, refer to chapter 4. If good, check for line trouble or refer to proper authority. Replace plugs in line jacks.
	11	Blank key	Lift SEND REC BREAK key to SEND. Press blank key twice.	The SEND REC BREAK key returns from SEND to REC the second time the blank key is depressed. (Prints and spaces in upper case of TT–6/FG only).	Refer to chapter 4.
	12	Signal bell	Press FIGS key, then S key.	Signal bell should ring	Refer to chapter 4.
	13	LTRS key and FIGS key.	Press FIGS key, then LTRS key (alternately) several times. *Note.* Teletypewriter may also be adjusted to unshift (return to LTRS position) on both space and LTRS.	Platen should rise to upper case when FIGS key is pressed and return to lower case when LTRS key is pressed.	Refer to chapter 4.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
EQUIPMENT PERFORMANCE	14	*a.* CAR RET. *b.* Manual carriage return.	Type-bar carriage at end of typed line. (Should also work from any part of typed line.) *Note.* Operates in LTRS position only on TT-6/FG.	Type-bar carriage returns to left.	Refer to chapter 4.
	15	Margin warning bell	Hold space bar down until type-bar carriage reaches end of line.	Bell should ring six characters before end of line.	Refer to chapter 4.
	16	LINE FEED	Press LINE FEED key (usually operated after CAR RET to give the carriage sufficient time for return operation). *Note.* LINE FEED operates only in LTRS position on teletypewriter TT-6/FG.	Paper rolls up one or two spaces as adjusted.	Refer to chapter 4.
	17	Space bar	*a.* Pressed down momentarily. *b.* Held pressed down. *Note.* Space operation also moves platen from FIGS to LTRS position unless unshift-on-space, mechanism is locked out (fig. 120).	*a.* Inserts single space (as between words). *b.* Sends repeated spaces while held operated.	Refer to chapter 4.
	18	Motor and governor	Hold space bar down with carriage at extreme left. *a.* Teletypewriter TT–5/FG. *b.* Teletypewirter TT–6/FG. *Note.* Motor should run 3 to 5 minutes before checking speed.	Margin warning bell rings *a.* At the end of 11 seconds. *b.* At the end of 12 seconds.	Refer to paragraph 22 for accuracy with speed indicator.
STOP	19	Remote motor control	Operate keys as follows: *a.* FIGS key. *b.* H (STOP) key.	*a.* Platen shifts to FIGS. position. *b.* Motor stops. *Note.* Affects all teletypewriters in circuit in the same manner.	Refer to chapter 4.

34. Operating Tests

a. Check motor speed as outlined in paragraph 22 and note whether the governor holds its setting.

b. Set the rangefinder (par. 22*e*).

c. Turn the crank to be sure that the paper feeds evenly and does not tear.

d. Operate the LINE FEED key. Check the line feed for both single and double spacing between lines by operating the single-double line feed lever to the desired position.

e. Operate the CAR RET key. Check for positive action and return to the left-hand margin without bouncing.

f. Observe the action of the ribbon-feed mechanism while typing to be sure it oscillates and feeds each time a character is typed. Check that the ribbon winds correctly in both directions and that the ribbon reverses correctly at both ends.

g. Test the manual carriage return feature by operating the carriage return lock bar.

h. Test the setting of the margin (end-of-line) bell warning by operating CAR RET, LINE FEED, FIGS followed by 1234567890 repeated

until it can be determined that the margin bell on the teletypewriter rings on the 66th character in the case of Teletypewriter TT–5/FG and on the 70th character in the case of Teletypewriter TT–6/FG.

i. Hold the space bar down to check the continuous spacing feature of the keyboard.

j. Test the remote motor control stop feature by operating CAR RET, LINE FEED, FIGS, and STOP (upper case H).

k. Test operation of the signal bell by pressing FIGS and BELL (upper case S).

l. Test the remote control start feature by a 2- or 3-second break signal (SEND REC BREAK key held in extreme downward position).

m. Operate the LTRS key and the FIGS key in succession, and notice that the platen shifts from the letters position to the figures position, and *vice versa* with positive action.

Caution: Check the operating procedure to determine whether the unshift-on-space feature is to be used. If this feature is not used, check the equipment carefully to be certain that this feature has been made inoperative and that the platen returns to the letters position *only* when the LTRS key is operated. This check is of particular importance because any equipment that has the unshift-on-space feature adjusted differently than the rest of the system becomes a source of trouble. The trouble is greatly increased when the equipment operates in a circuit with cryptographic equipment.

n. Check the type alinement by operating FIGS, 2, LTRS, and W in succession across the page, and note whether the characters are on an even line.

o. Check the general typing functions of the teletypewriter by typing a test sentence several times. A typical test sentence is: THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 123456789Ø TESTING (followed by a carriage return and a line feed). See that all type pallets print clean, properly positioned characters.

p. With the SEND REC BREAK key in the REC position, test the keyboard to be sure that the sending mechanism is inoperative and that nothing can be transmitted.

q. With the SEND REC BREAK key in the SEND position, type two consecutive blank characters to determine that the SEND REC BREAK mechanism will automatically move to the REC position (operates in LTRS position only on TT–6/FG).

r. With the SEND REC BREAK key in SEND position, type one blank character alternately with any other letter or number character to determine that the single blank characters do not affect the SEND position of the SEND REC BREAK key mechanism.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

35. Emergency Operation

If the teletypewriter breaks down, proceed as follows:

a. Notify the maintenance unit at the station.

b. Notify the other stations on the circuit of the trouble, and estimate, if possible, the length of time before operation can be resumed.

c. Check the equipment in accordance with preventive maintenance procedures outlined in chapter 3.

d. Try to determine visually where the trouble is. Determine whether it is electrical or mechanical and in which of the components it appears to have occurred. If the trouble seems to be in the power line or any of the signal circuits, report the trouble to the proper maintenance authority.

36. Operation Under Adverse Climatic Conditions

a. General.

(1) Operation and maintenance of teletypewriter equipment in arctic, tropical, or desert regions involve a number of problems peculiar to these regions. Moisture condensation due to extreme humidity or to rapid decreases in temperature causes short circuits and cross-fire. Deterioration of parts due to rust and corrosion may lead to complete break-down of the equipment. Dust, dirt, or sand encountered in desert regions will affect operation and may lead to break-down.

(2) Keep the equipment as dry as possible in order to prevent corrosion. In extremely

cold regions heat the shelter in which the teletypewriter is installed and to the greatest extent possible avoid changes (drops) in temperature. Whenever possible make sure that the ground rod, if used, is driven below the frost line.

(3) The information contained in *b* through *d* is intended as a general guide when necessary to operate the teletypewriters under adverse conditions.

b. Arctic Conditions. Before placing the equipment in operation:

(1) Provide a source of heat.

(2) See that the equipment has been lubricated with special lubricants designed to protect it at extremely low temperatures. Apply kerosene freely to the type-bar segments, but be careful to confine it to the segments only.

(3) Let the equipment warm up before placing it under load. Let the motor units run for *at least* 15 minutes.

(4) At extremely low temperatures, metals may contract at different rates, and normal clearance in the mechanical parts of the equipment will be disturbed. Also, metal parts may crystallize, become brittle, and may break under load when exposed to these conditions. Therefore, do not attempt to operate these teletypewriters at temperatures below 40° F.

c. Tropical Conditions.

(1) In tropical regions the equipment may be exposed to conditions of high temperature and humidity. The equipment must, therefore, be protected against the effects of moisture and fungus. Refer to paragraph 45 for moistureproofing and fungiproofing of these teletypewriters.

(*a*) Provide adequate ventilation around the motor units and the rectifier power unit to prevent overheating. See that the equipment is lubricated with approved lubricants specified for use in the region.

(*b*) Check the condition of the weatherproof coating. If it is damaged, apply another coat as soon as possible.

(*c*) Keep the equipment clean. If possible, screen the shelter against entry of insects.

(2) In tropical areas, teletypewriter sets may be installed in tents, huts, or in some cases, dugouts. If installed below the ground and, frequently, if equipment is set up in swampy areas, moisture conditions are more acute than normal in the tropics. Generally under these conditions ventilation is very poor, and the relatively high humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the surrounding area. Lighted electric bulbs should be placed under the equipment to minimize this action. Often one bulb must be kept lighted continuously in order to keep a constant temperature.

(3) Be careful to properly lubricate gears and friction clutch felt washers in high temperatures. *It is extremely important to avoid overlubrication.*

d. Desert Conditions. Conditions in desert regions are similar to those in tropical areas except for the humidity. Dryness of the atmosphere may require more frequent lubrication. Dirt and dust can seriously damage bearings and moving parts of the mechanism. When necessary, measures similar to those given for tropical conditions may be applied.

(1) Protect the equipment against dust, dirt, and sand.

(2) Provide adequate ventilation to prevent overheating.

(3) See that proper lubricants are used to protect the equipment. The chief problem that arises while operating in desert areas is the great accumulation of dust and dirt that gets into the moving parts of the teletypewriter. The ideal solution to this problem is to house the equipment in a dustproof shelter. Such a building, however, requires air-conditioning facilities. When a suitable building or shelter is found, the installers should use all available materials to make the building or shelter as dustproof as possible. They should hang wet sacking over the doors and windows, cover the inside walls with heavy paper, and, if tents are used, the side walls should be well secured and banked with dirt to prevent flapping

in the wind. Tents should be provided with double flaps, and buildings should have double doors to serve as light traps or baffles.

(4) Do not tie power cords, signal cords, or other wiring connections to either the inside or outside of tents, since desert areas are subject to sudden winds which are apt to jerk the connections loose or break the lines.

(5) Frequent preventive maintenance checks should be made.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

37. Tools

Tools necessary for preventive maintenance procedures for Teletypewriters TT–5/FG and TT–6/FG are furnished in Tool Equipment TE–50 or TE–50–A. With early models of Teletypewriters TT–5/FG and TT–6/FG, Tool Equipment TE–50 was furnished. With later models, Tool Equipment TE–50–A is furnished. In Tool Equipment TE–50–A, Multimeter TS–297/U replaces Test Unit I–236 which was furnished in Tool Equipment TE–50.

38. Materials

Materials needed in addition to those included in Tool Equipment TE–50 or TE–50–A are listed below and are obtainable through regular supply channels.

Signal Corps stock No.	WECo Code No.	Description
6Z7360	KS–6320	Stick, orange.
SA805		Cheesecloth, bleached; 36″ wd.
6Z2000		Cloth, emery; crocus; 9″ x 11″ sheets (spec 42C56–Navy).
6G184.2		Carbon tetrachloride.
6G1325	KS–7470	Oil, lubricating, Teletype part No. 88970.
6G1318.1		Oil, lubricating, preservative, special (PL) JAN–L–644.
6G650	KS–7471	Grease, lubricating, special, Teletype part No. 88973.
6G673.7		Grease, lubricating, special (GL) Ordnance spec No. AXS–637.
6M750	KS–7188	Paper, cleaning; Bell Seal bond; ¼″ x 2½″.
6Z7500–0000		Paper, sand, flint; #0000; 9″ x 11″ sheets, Fed. spec P–P–111.
6G1516		Polish, metal, paste.
(See note 1)		Solvent, dry-cleaning (SD) Fed. spec No. P–S–661a. (See note 2).

Note 1. Quartermaster Corps No. 51–S–4385–I.

Note 2. Gasoline will not be used as a cleaning fluid for any purpose. Solvent (SD) is available as a cleaning fluid through established supply channels. Oil, fuel, Diesel (DA) may be used for cleaning purposes when solvent (SD) is not available. Carbon tetrachloride will be used as a cleaning fluid only in the following cases: where inflammable solvents cannot be used because of the fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

Section II. LUBRICANTS AND PRESERVATIVES

Note. A Department of the Army Lubrication Order is not issued on Teletypewriters TT–5/FG and TT–6/FG.

39. Recommended Lubricants

Lubricating materials necessary in servicing Teletypewriters TT–5/FG and TT–6/FG:

Approved Symbols	Lubricant
KS–7471	Grease, lubricating, special, Teletype part No. 88973.
KS–7470	Oil, lubricating, Teletype part No. 88970.*
OE 10	Oil, engine, SAE 10.*
	Grease gun for ball oilers (motor).

*When the temperature is so high that lubricating oil (KS–7470) runs off the parts, engine oil (OE 10) may be substituted.

40. Lubrication Schedules

Schedule lubrication to allow for variations in wear resulting from differences in temperatures and in average hours of use per day.

a. Schedule When Operating at Average Temperatures. The recommended lubrication schedule for operation under average temperature conditions is given in the following table:

Operation schedule	Lubrication schedule
Up to 8 hours per day	Every 30 days.
8 to 12 hours per day	Every 20 days.
12 to 16 hours per day	Every 15 days.
16 to 24 hours per day	Every 10 days.

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b. Schedule for Main Shaft. The interval between lubrications of the main shaft should be one-fourth as long as the interval between lubrications scheduled for the rest of the equipment.

c. Schedule When Operating in Tropical or Desert Climates. Reduce the interval in the appropriate schedule (*a* and *b* above) by one-half when operating in tropical or desert climates.

Caution: When lubricating the equipment at frequent intervals be extremely careful to avoid the accumulation of excessive oil.

41. Detailed Lubrication Instructions

a. Methods of Applying Grease.

(1) *General.* When grease is specified, use special lubricating grease (KS–7471). Pay particular attention to the information following the item in the lubrication charts indicating location, number of points, the amount or method of applying the lubricant, and any difference between initial and later lubrication. Grease both loops of all springs that exert a tension of 2½ pounds or more.

(2) *Filling of grease gun.* Fill the grease gun, which is furnished as part of Tool Equipment TE–50 or TE–50–A, in the following manner:

(*a*) Unscrew the lubricant tube from the cap casting.

(*b*) Place the opened end of the lubricant tube over the opening in the filling washer in the can of proper lubricant. Press down on the lubricant tube until the tube is filled.

Note. If the cans of lubricant available are not equipped with filling washers, press the metal follower against the back end of the lubricant tube, and fill the lubricant tube by using a clean wooden paddle or the fingers. Tamp the lubricant down solidly in the tube by pounding the closed end sharply against the palm of the hand. Continue to add lubricant and tamp until the tube is completely filled.

(*c*) Screw the lubricant tube back into the cap casting just enough to hold the tube in place. Insert a rod, screw driver, pencil, or similar object through the perforated end of the lubricant tube, and press the metal follower into the tube to expel any air that may be trapped in the tube. When the lubricant begins to ooze past the threads, tighten the lubricant tube securely into the cap casting.

(*d*) Operate the handle back and forth several times until lubricant is pumped from the nozzle. The grease gun is then ready for use. If the lubricant does not flow from the nozzle in a solid stream when the handle is operated, it is an indication that all the air has not been expelled from the lubricant tube. Invert the gun and pound the cap casting end against the palm of the hand to jar the lubricant into the pump cylinder.

(3) *Greasing pressure fittings.* To grease parts that are equipped with pressure fittings (ball oilers), place the nozzle of the grease gun squarely against the grease fittings and operate the handle. Test the grease gun *before* greasing pressure fittings to determine how much grease is injected for each full operation of the handle. *Do not overlubricate equipment.*

(4) *Greasing flat surfaces.* To grease flat surfaces, hold the nozzle of the grease gun against the surface, tilted at an angle of approximately 45°. Operate the handle until sufficient grease is ejected. If the surface is long, operate the handle slowly and at the same time move the nozzle of the gun along the surface to form a continuous ribbon of lubricant. The lubricant may be pumped out onto the fingers or the end of a screw driver for transfer into hard-to-reach places that cannot be reached directly with the grease gun.

b. Methods of Applying Oil.

(1) *General.* Unless grease is specified, apply 1 or 2 drops (or more when specifically indicated) of oil (KS–7470) to the parts specified in the lubrication charts. Oil, engine OE 10 (SAE 10) may be substituted for KS–7470 oil if KS–7470 oil is not available. Oil both loops of all springs that exert a tension of less than 2½ pounds.

(2) *Filling of oiler.* Fill the oiler furnished as part of Tool Equipment TE–50 or TE–50–A by unscrewing the top and removing

the pump. Fill the tube with proper lubricant and replace the pump. Tighten the top.

(3) *Use of oiler.* After filling the oiler, or when starting to use the oiler after it has been standing for some time, operate the pump handle until oil is forced out of the nozzle, and then adjust the stop beneath the pump handle for the desired flow of oil. Turn the adjusting screw in a counterclockwise direction to reduce the flow of oil and in a clockwise direction to increase the flow of oil. The adjustable stop beneath the pump handle may be moved to one side to make the stop inoperative.

(4) *Use of wire for applying oil.* A piece of #22 B & S gage wire dipped one-half inch into the oil and immediately touched to the lubrication point is an approved method of applying 1 or 2 drops of oil. The main advantage of this method is that it avoids overlubrication.

42. Preparation for Lubrication

a. GENERAL. To lubricate the teletypewriter thoroughly, it must be taken out of service and partially disassembled as outlined in *c* below.

b. GREASE GUN. Fill the grease gun and oiler as described in paragraph 41*a* (2) and *b* (2).

c. DISASSEMBLY. To facilitate lubrication of various parts and units, disassemble as follows:

(1) Disconnect the power during the lubricating process.

(2) Remove the cover.

(3) Remove the roll of paper and paper spindle from the typing unit.

(4) Remove the typing unit from the base, then remove the type-bar carriage.

(5) Remove the keyboard.

d. CLEANING. With a soft clean brush or a clean lint-free cloth lightly dampened with solvent (SD) clean all parts to be lubricated. Wrap the cloth around the end of a screw driver or an orange stick to remove old grease and oil in hard-to-reach places. Wipe dry with a clean lint-free cloth before lubricating.

e. LUBRICATION. Location of the parts of the teletypewriter to be lubricated are shown in figures 63 through 77. The type of lubricant to be used and specific instructions for lubricating each part are given in the charts in paragraph 43. Items need not be lubricated in the sequence given in the charts, but all points must be lubricated. Do not lubricate the teletypewriter with the motor running. After lubricating, wipe off excess lubricant with a clean lint-free cloth.

Caution: Do not apply lubricants in excess of the quantities recommended. Wipe off excess oil.

43. Lubrication Charts for Teletypewriters

The charts in this paragraph list the points to be lubricated, the type of lubricant, and the quantity to be applied. Item numbers are grouped by units and include all points to be lubricated on each unit. The item numbers are shown on referenced illustrations.

a. MOTOR UNIT AND BASE.

Item No. and fig.	Name of part	Lubricant	Method and quantity
	Motor unit		
1, 63	Motor pinion and main-shaft gears	KS–7471	Apply sparingly.
2, 63	Motor bearing oilers (2)	KS–7471 or KS–7470	Apply grease with gun or 4 or 5 drops in each.
3, 63	Governor-adjusting lever pilot screw	KS–7470	1 or 2 drops.
	Base (SEND REC BREAK mechanism)		
4, 63	Operating-lever shoulder screw	KS–7470	1 or 2 drops.
5, 63	Lower contact-lever shoulder screw	KS–7470	1 or 2 drops.
6, 63	Stop-lever shoulder screw	KS–7470	1 or 2 drops.
7, 63	Send-receiver-break levers at mounting screw	KS–7470	1 or 2 drops in each.

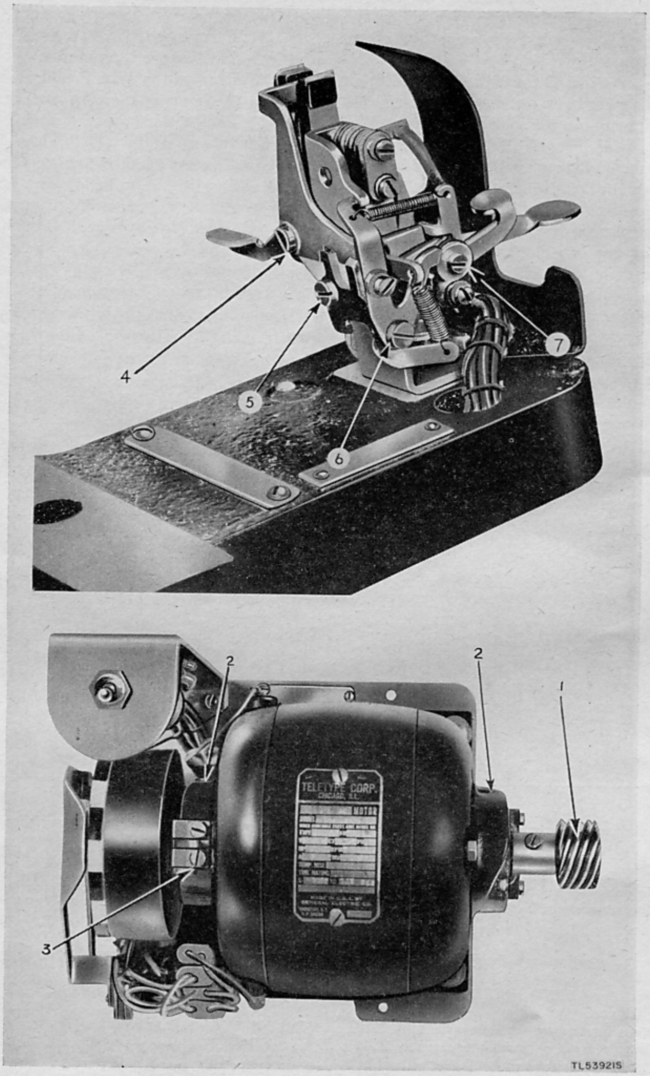

Figure 63. Motor unit and base, lubrication points.

b. LUBRICATION ON BOTTOM OF KEYBOARD.

Item No. and fig.	Name of part	Lubricant	Method and quantity
	Keyboard unit		
101, 64	Selector bars, in slots and rollers	KS-7470	1 or 2 drops each.
102, 64	Universal-bar pilot screws, on bearings	KS-7470	1 or 2 drops each.
103, 64	Trip-off pawl link joint	KS-7470	1 or 2 drops.
104, 64	Keylevers, on keylever shaft and keylever spring plate	KS-7470	1 or 2 drops.
105, 64	Locking levers, between pins in selector bars	KS-7470	1 or 2 drops.

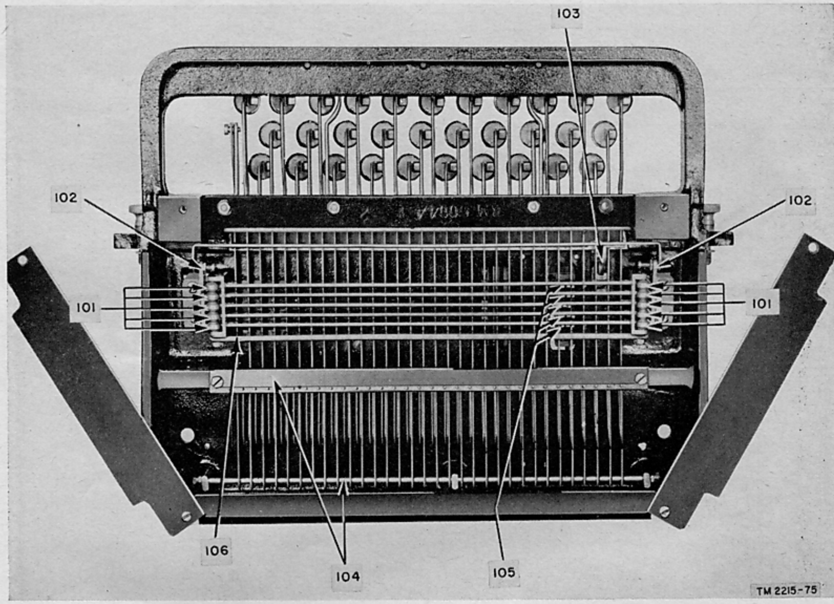

Figure 64. Bottom of keyboard, lubrication points.

c. Lubrication on Top Side of Keyboard.

Item No. and fig.	Name of part	Lubricant	Method and quantity
106, 65	Keylevers, in front and rear keylever guides (combs) (64 points).	KS–7470	1 or 2 drops.
107, 65	Space-bar loop at space-bar loop shaft	KS–7470	1 or 2 drops.
108, 65	Transmitting shaft (2 oil cups)	KS–7470	Fill cups.
109, 65	Keyboard transmitting-shaft clutch sliding member	KS–7470	1 or 2 drops.
110, 65	Cams, on surfaces (6)	KS–7471	Apply a light film.
111, 65	Lock-loop pilot-screw bearings and roller	KS–7470	1 or 2 drops at each point.
112, 65	Contact-lever pivoting shaft and guiding comb	KS–7470	1 or 2 drops at each point.
113, 65	Locking levers, in locking-lever comb	KS–7470	1 or 2 drops.
114, 65	Clutch throw-out lever bearings	KS–7470	1 or 2 drops.
115, 65	Trip-off and intermediate pawls	KS–7470	1 or 2 drops.
116, 65	Keyboard transmitting-shaft gear	KS–7471	Apply sparingly.
117, 65	Space-repeat rod on each bearing, bushing, or point of contact.	KS–7470	1 or 2 drops.

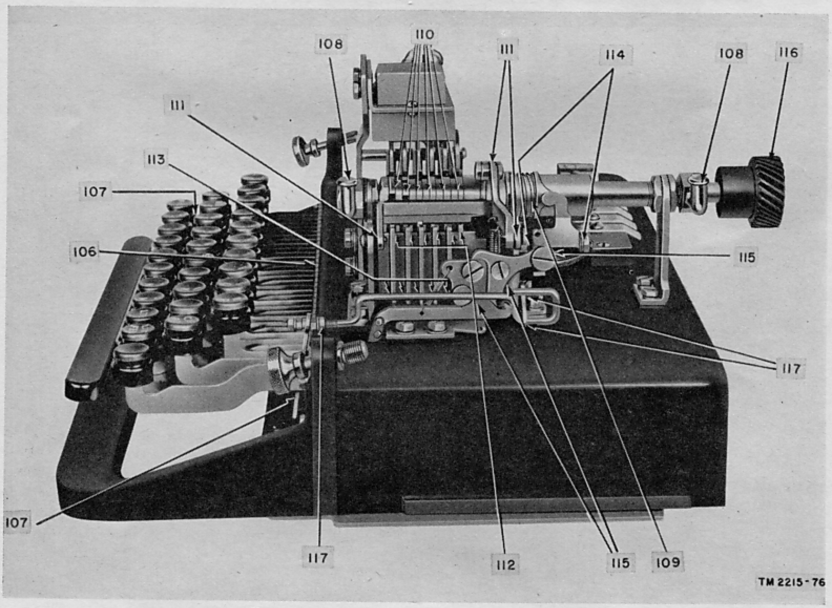

Figure 65. Top of keyboard, lubrication points.

d. TYPE-BAR CARRIAGE ASSEMBLY.

Item No. and fig.	Name of part	Lubricant	Method and quantity
201, 66	Type bars at each of 26 segment slots	KS–7470	1 or 2 drops.
202, 66	Code bars, at posts	KS–7470	1 or 2 drops.
203, 66	Code-bar bell cranks, on wearing surfaces	KS–7470	1 or 2 drops.
204, 66	Pull-bar bail, on guide rollers and guide surface	KS–7470 and KS–7471	Apply 1 or 2 drops of oil, then apply grease, then apply 1 or 2 drops of oil on the grease.
205, 68	Pull-bar bail plunger surface and rollers and surface of pull-bar bail guide post.	KS–7470 and KS–7471	Apply same as for item 204.
206, 68	Pull-bar bail plunger guide roller (operating bail roller)	KS–7471 and KS–7470	Apply the same as for item 204.
207, 68	Carriage-support rollers	KS–7470	1 or 2 drops.
208, 68	Ribbon-reverse bail	KS–7470	1 or 2 drops.
209, 68	Ribbon-feed shaft bearings	KS–7470	1 or 2 drops (3 oilholes).
210, 68	Ribbon-feed pawl feed lever	KS–7470	1 or 2 drops.
211, 68	Ribbon-feed pawl pivot screw and wearing surfaces	KS–7470	1 or 2 drops each.
212, 68	Ribbon-feed rachet	KS–7470	1 or 2 drops.
213, 67	Ribbon lock-out bar, at type-bar segment slot	KS–7470	1 or 2 drops.
214, 66	Ribbon vertical feed shaft, on upper and lower bearings	KS–7470	1 or 2 drops.
215, 66	Ribbon-feed mechanism gears	KS–7470	Apply sparingly to gears.
216, 67	Ribbon-spool shafts on bushings (remove spools)	KS–7470	2 or 3 drops.
217, 68	Ribbon-reverse shafts, upper and lower bearings, arms, pawls, and levers.	KS–7470	1 or 2 drops.
218, 67	Margin-bell pawl, at bottom of pawl	KS–7470	1 or 2 drops.
219, 67	Ribbon-shift lever and roller	KS–7470	1 or 2 drops.
220, 67	Ribbon-oscillator-lever shoulder screw and carriage-casting slot.	KS–7470	1 or 2 drops.
221, 67	Spacing rack teeth, spacing gear, and travel	KS–7470	1 or 2 drops.
222, 68	Ribbon reverse detent roller	KS–7470	1 or 2 drops.
223, 68	Ribbon-feed shaft detent	KS–7471	Apply sparingly.

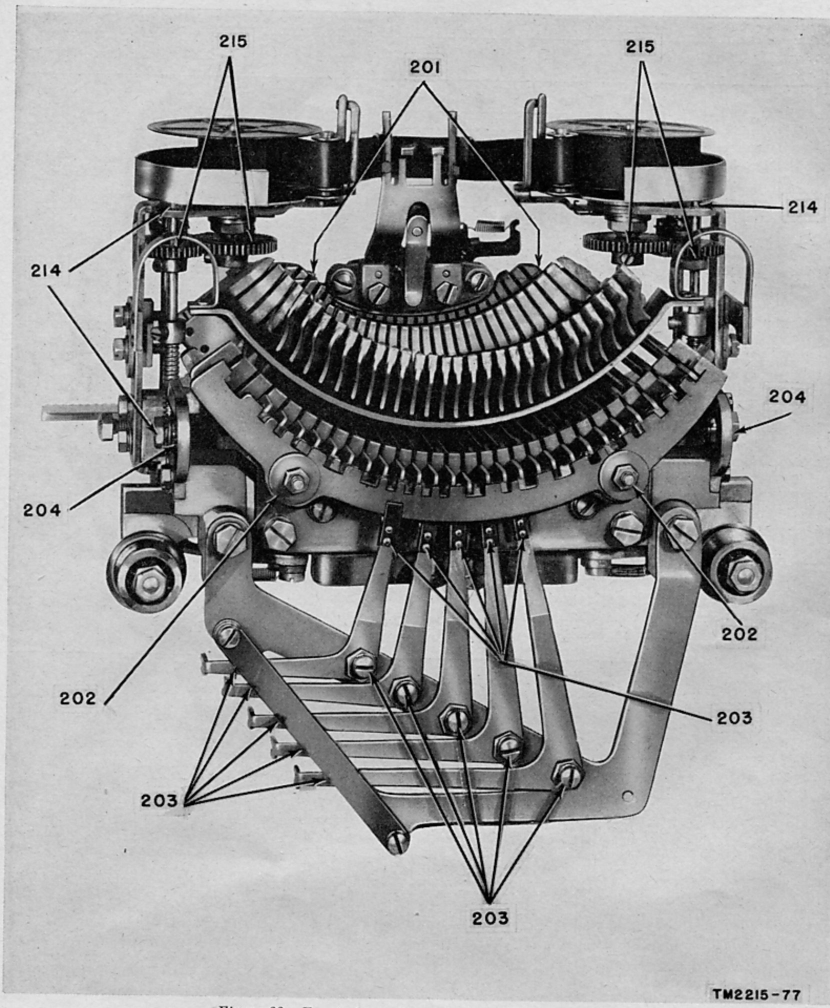

Figure 66. Front of type-bar carriage, lubrication points.

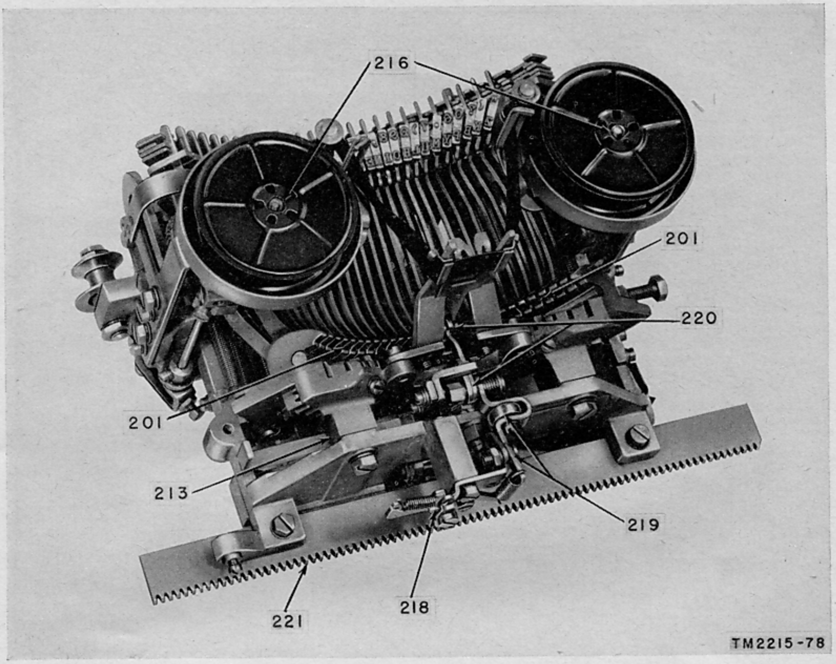

Figure 67. Top—rear of type-bar carriage, lubrication points.

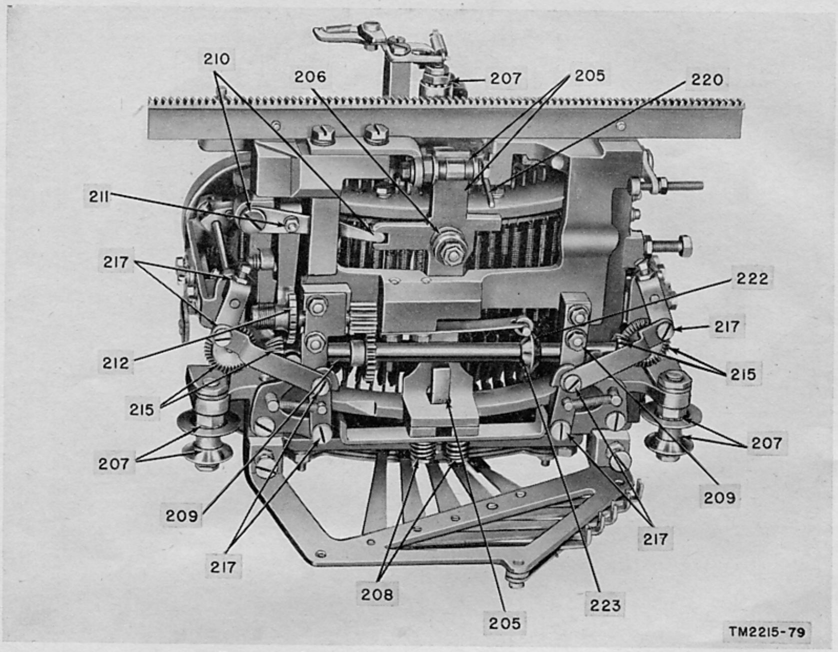

Figure 68. Bottom of type-bar carriage, lubrication points.

e. Typing Unit.

Item No. and fig.	Name of part	Lubricant	Method and quantity
	Bail unit assembly		
301, 69	Bail-assembly shaft bearings (2 oil cups, new style)	KS–7470	Fill cups.
302, 69	Between spacing pawls	KS–7470	1 or 2 drops.
303, 69	Function-bail and printing-bail operating-arm bearings.	KS–7470	1 or 2 drops at each point.
304, 69	Function-lever bail roller (2 bearings)	KS–7471	Apply 1 or 2 drops of oil, then grease, then 1 or 2 drops of oil on the grease.
305, 69	Function-lever bail roller surface	KS–7471	Apply film of grease.
306, 69	Function-bail and printing-bail operating arm rollers	KS–7471	Same as for item 304 above.
307, 71	Printing-bail blades where pull-bar bail plunger guide roller engages blades (inside of both blades).	KS–7470	1 or 2 drops.
308, 71	Printing-bail, adjusting screwhead	KS–7471	Apply sparingly.
	Vane frame assembly		
309, 70	Function levers, in vane frame slots	KS–7470	1 or 2 drops.
310, 70	Function levers and motor-stop contact levers, in slots in send-receive-break mechanism plate.	KS–7470	1 or 2 drops.

Item No. and fig.	Name of part	Lubricant	Method and quantity
311, 70	Push bars and latch bars, in function-lever comb	KS-7470	1 or 2 drops.
312, 71	Sixth-vane extension spring, in slot in letters (unshift) push bar (pilot).	KS-7470	1 or 2 drops.
313, 71	Vane pivot (pilot) screw	KS-7470	1 or 2 drops.
314, 71	Send-receive-break mechanism intermediate-lever mounting screw and reset-lever shoulder and pivot screws (be careful not to get oil on friction spring washer of send-receive-break mechanism T-lever).	KS-7470	1 or 2 drops.
315, 71	Vanes along front edges, where bell cranks slotted ends slide in engagement with vanes.	KS-7470	1 or 2 drops.
316, 71	Sixth-vane detent roller (back of vanes)	KS-7470	1 or 2 drops.
317, 70 and 71.	Locking function lever (6 points)	KS-7471	Apply grease in notches.
	Spacing shaft assembly		
318, 70	Vertical spacing shaft, in upper bearing; lower bearing, fill oil cup.	KS-7470	1 or 2 drops.
319, 70 and 72.	Carriage-return, clutch-driven, and driving member prongs.	KS-7470	1 or 2 drops.
320, 70	Spacing gear (lower)	KS-7471	Apply sparingly.
	Carriage-return mechanism		
321, 72	Carriage-return latch bar, at point of engagement with latch.	KS-7471	Apply sparingly.
322, 72	Carriage-return, clutch-release fork wearing surface and operating-lever bearings.	KS-7470	1 or 2 drops.
323, 72	Carriage-return latch bar, reset bar, and operating-lever shoulder screw.	KS-7470	1 or 2 drops.
324, 72	Carriage-return lock-bar latch-link upper shoulder screw.	KS-7470	1 or 2 drops.
325, 72	Carriage-return spring drum bearing	KS-7470	1 or 2 drops.
326, 72	Carriage-return spring drum release-lever shoulder screw.	KS-7470	1 or 2 drops.
327, 72	Lock-bar latch-link lower shoulder screw	KS-7470	1 or 2 drops.
328, 72	Upper arm latch bell-crank lower shoulder screw	KS-7470	1 or 2 drops.
329, 72	Lock-bar and upper arm latch, bell-crank shoulder screw.	KS-7470	1 or 2 drops.
330, 72	Lock-bar latch and left-hand side-frame shoulder-screw.	KS-7470	1 or 2 drops.
331, 72	Dash-pot piston rod, rubbed over surface of piston	KS-7470	1 drop.
332, 72	Dash-pot lever mounting screw, roller mounting pilot screw, and point of contact with left-hand margin adjusting screw.	KS-7470 and KS-7471	Apply sparingly; oil screws and roller; apply grease at point of impact from carriage return.
333, 71	Type-bar carriage assembly upper and lower track surfaces and groove.	KS-7470	1 or 2 drops.
334, 72	Carriage-return spring, through oilholes in drum	KS-7470	1 or 2 drops.
335, 72	Spacing stop lever and shoulder screw	KS-7471	Apply sparingly.
336, 72	Carriage-return operating-lever stop screw	KS-7471	Apply sparingly.
	Signal bell function		
337, 77	Signal bell hammer arm and arm operating-lever bearings.	KS-7470	1 or 2 drops.
338, 77	Signal bell reset bar and latch-bar shoulder screw	KS-7470	1 or 2 drops.
339, 70	Signal bell latch bar, at point of engagement with latch.	KS-7471	Apply sparingly.

Item No. and fig.	Name of part	Lubricant	Method and quantity
	Shift-unshift mechanism		
340, 77	Shift link shoulder screw and shift and unshift push-bar shoulder screws (3).	KS–7470	1 or 2 drops each.
341, 77	Shift lever shoulder screw	KS–7470	1 or 2 drops.
342, 77	Shift (horizontal) link extension and shift lever joint	KS–7470	1 or 2 drops.
343, 77	Shift vertical link shoulder screw	KS–7470	1 or 2 drops.
	Line-feed function		
344, 77	Line-feed push bar and line-feed bail shoulder screw	KS–7470	1 or 2 drops.
345, 77	Line-feed bail mounting shaft	KS–7470	1 or 2 drops.
346, 77	Line-feed vertical link and line-feed bail shoulder screw.	KS–7470	1 or 2 drops.
	Margin bell		
347, 77	Margin-bell cam shaft, 2 bearings	KS–7470	1 or 2 drops.
	Main shaft		
351, 73	Main shaft	KS–7470	Hold right end of teletypewriter up about 6 inches and remove oil plug. Fill shaft until oil runs out of the left end.
352, 73	Main-shaft clutch, driven member	KS–7470	Oil freely.
353, 70	Main-shaft clutch throw-out lever pivots	KS–7470 and KS–7471	Apply sparingly; oil, then grease, then oil—1 or 2 drops before and after greasing.
354, 73	Main-shaft friction washers (4)	KS–7470	Saturate with oil.
355, 73	Locking-cam and felt washer on selector-cam assembly.	KS–7470	1 or 2 drops on cam, saturate felt washer.
356, 73	Selector-cam sleeve, on each cam peak (6)	OE 10	1 or 2 drops each.
357, 73	Main-shaft right ball bearing	KS–7470 and KS–7471	Apply 1 or 2 drops of KS–7470, turn shaft; apply thin coat of KS–7471; turn shaft a few turns; apply 1 or 2 drops of KS–7470.
358, 73	Main-shaft left ball bearing	KS–7471 and KS–7470	Same as item 357.
359, 73	Thrust bearing, on end bells	KS–7470	1 or 2 drops.
360, 73	Spacing-clutch spring coils	KS–7470	Permit oil to flow between prongs of driven member of spacing clutch and worm gear sleeve.
361, 73	Spring which compresses friction washers of selector-cam assembly.	KS–7470	Apply sparingly to coils (oil will flow between prongs of nut on main shaft and friction disk which engages this nut).
362, 73	Spacing gear unit stop sleeve, unit of spacing clutch, and printing-bail cam unit (2 oil holes).	KS–7470	1 or 2 drops in each.
363, 73	Main-shaft clutch caming surface	KS–7470	1 or 2 drops.
364, 73	Printing-bail and function-bail cam surfaces	KS–7471	Apply sparingly.
365, 73	Spacing escapement ratchet teeth	KS–7471	Apply sparingly.
	Selector unit		
375, 75	Armature bearings (2)	KS–7470	1 or 2 drops each.
376, 76	Trip-latch plunger, trip latch, bell crank lever, and stop lever of range finder assembly.	KS–7470	1 or 2 drops each.
377, 75	Swords and selector levers, between separating plates.	KS–7470	1 or 2 drops each plate.

Item No. and fig.	Name of part	Lubricant	Method and quantity
378, 75	T levers, on all points of contact	KS–7470	1 or 2 drops.
379, 75	Armature locking lever at mounting post and contact surface.	KS–7470	1 or 2 drops.
380, 75	Locking wedge, at point of engagement with locking lever. *Note.* Selector-cam sleeve is listed under main shaft.	KS–7470	1 or 2 drops.
	Motor-stop mechanism		
381, 70 and 75.	Motor-stop pawls shoulder screw and both motor-stop lever bearings. (Right bearing under right side of sword separating plates.)	KS–7470	1 or 2 drops.
382, 70 and 75.	Motor-stop release-lever bearing, eccentric and contact surfaces, motor-stop contact-lever bearing, and at points where contact lever wears motor-stop lever extension and protrudes through break mechanism plate in front of typing unit. (Points not marked are under selector or typing unit.)	KS–7470	1 or 2 drops.

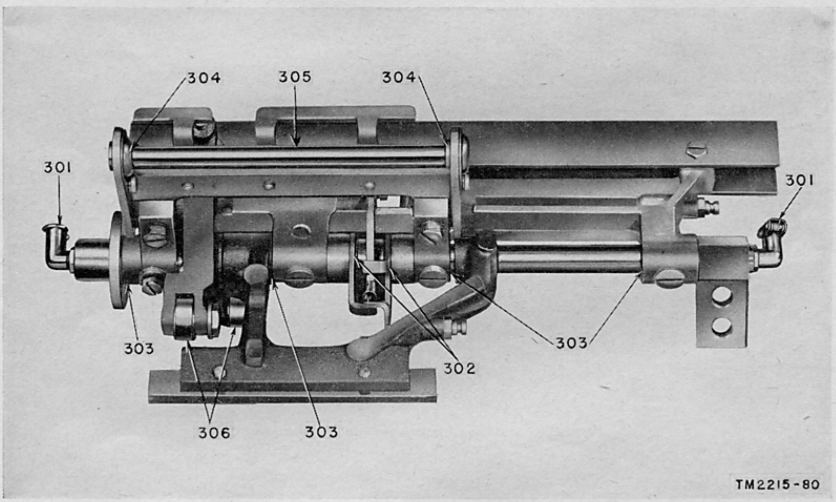

Figure 69. Bail-unit assembly, lubrication points.

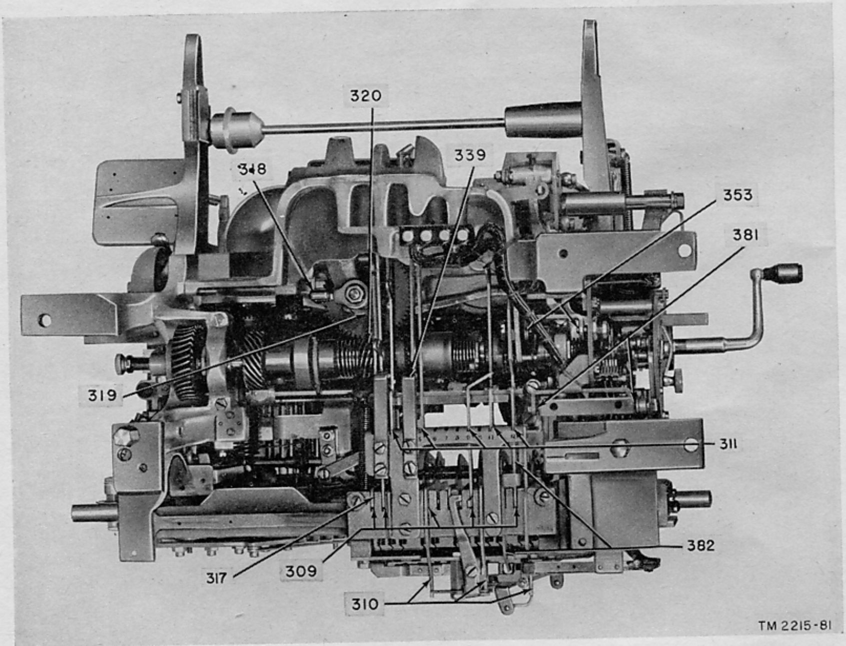

Figure 70. Bottom of typing unit, lubrication points.

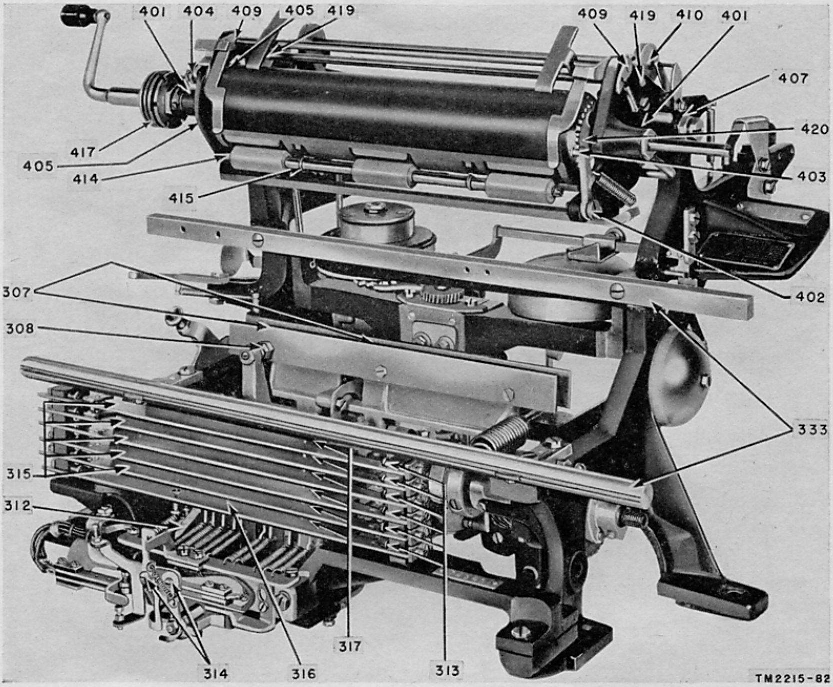

Figure 71. Front of typing unit, lubrication points.

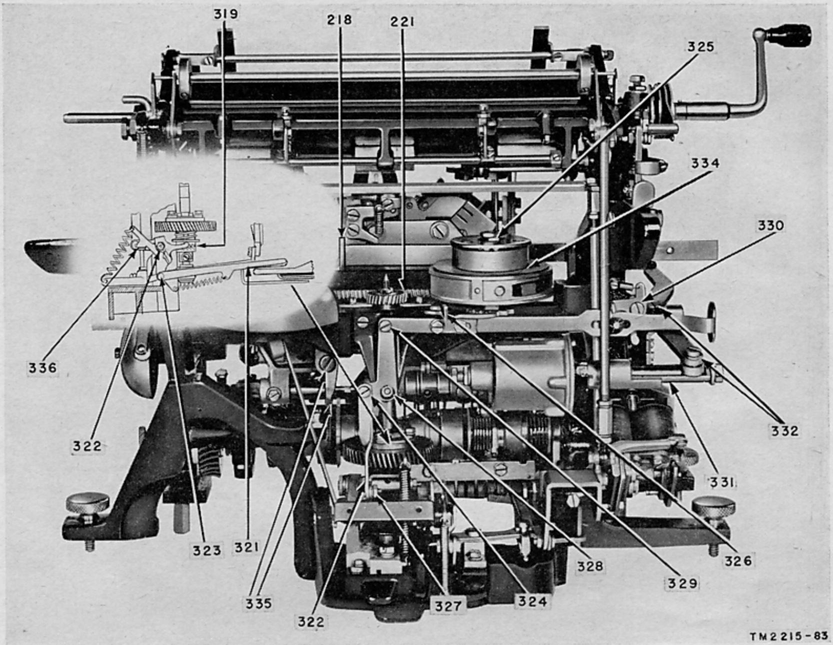

Figure 72. Carriage-return mechanism, lubrication points.

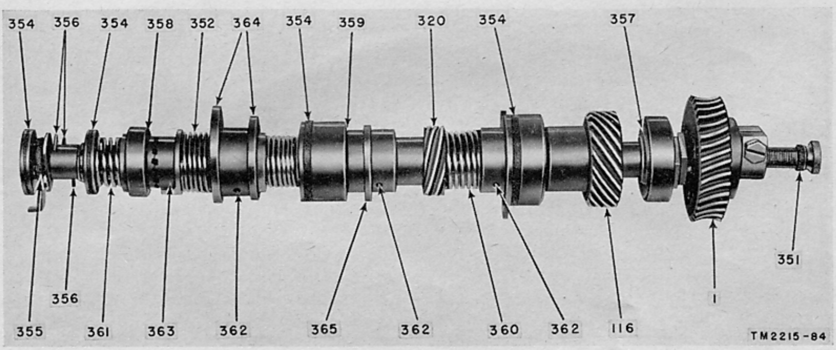

Figure 73. Main shaft, lubrication points.

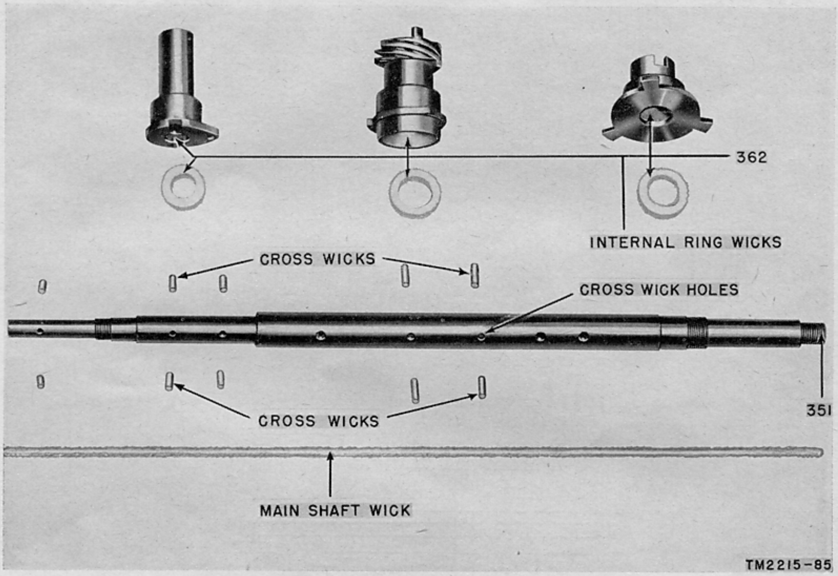

Figure 74. Main shaft, with lubrication wicks.

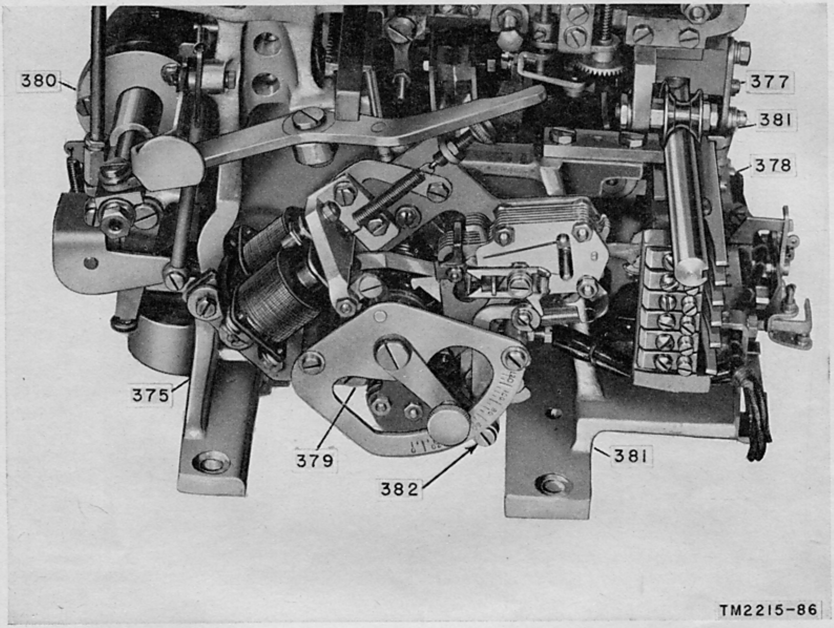

Figure 75. Selector mechanism, lubrication points.

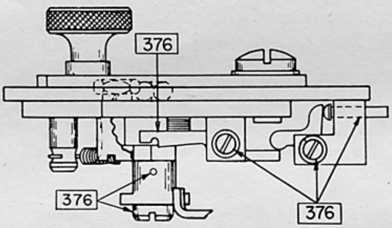

Figure 76. Selector mechanism rangefinder, lubrication points.

f. Typing Unit Less Type-Bar Carriage Assembly.

Item No. and fig.	Name of part	Lubricant	Method and quantity
	Platen unit		
401, 71	Platen shaft bearings, in each shaft hub	KS-7470	1 or 2 drops.
402, 71	Line-feed detent-lever eccentric shoulder screw	KS-7470	1 or 2 drops.
403, 71	Line-feed detent roller	KS-7470	1 or 2 drops.
404, 71	Single-double line-feed lever between flat line-feed detent spring and line-feed detenting cam, and where single-double line-feed lever fits into groove in platen shaft hub.	KS-7470	1 or 2 drops.
405, 71	Line-feed pawl and single-double line-feed lever shoulder screw.	KS-7470	1 or 2 drops.
406, 77	Platen shift-detent roller	KS-7471	Apply sparingly.
407, 77	Platen unit (pilot screws) bearings bushings	KS-7470	1 or 2 drops.
408, 77	Line-feed and shift vertical links (upper ends)	KS-7470	1 or 2 drops.
409, 71	Paper-finger supporting arms paper-guide bearings	KS-7470	1 or 2 drops.
410, 77	Paper-straightener rod lever bearings	KS-7470	1 or 2 drops.
411, 77	Paper-straightener rod supporting bearings	KS-7470	1 or 2 drops.
412, 77	Pressure-roller-release shaft and crank bearings	KS-7470	1 or 2 drops.
413, 77	Pressure-roller-release cams, release lever bearings, and spring-adjusting lever shoulder screws (6 points).	KS-7470	1 or 2 drops.
414, 71	Pressure-roller shafts, on bearing surfaces (2 shafts, 4 points).	KS-7470	1 or 2 drops.
415, 71 and 77	Pressure rollers (at each end and between rollers, at spacer junctions).	KS-7470	1 drop on each.
416, 77	Letters and figures stop screws (2)	KS-7470	Grease ends.
417, 71	Platen friction disk assembly, felt washers (with disks spread apart), separating disks.	KS-7470	Saturate with oil.
418, 77	Paper-spindle bearings	KS-7470	1 or 2 drops.
419, 71	Line-feed check-lever shaft bearings (each end)	KS-7471	Apply grease sparingly, or 1 or 2 drops of oil if sticking.
420, 71	Line-feed detent ratchet	KS-7471	Apply sparingly.
421, 77	Left end of platen shaft before installing platen crank	KS-7470	1 or 2 drops.

g. Motor-Unit Bearings.

(1) The motor bearings are packed with grease before the motor leaves the factory and under ordinary operating conditions need no additional lubrication for approximately 2 months. At times, when only a motor bearing and not an entire motor unit is received, the bearing may be covered only with cosmoline to prevent corrosion. *Do not mistake this for the type of lubricant designated for motor-unit bearings.* At the regular lubricating intervals, one or two strokes of the plunger of the gun should apply sufficient grease to each bearing.

(2) To lubricate, press the nozzle of the gun against the ball oiler pressure fitting and force the grease into the hole by pushing on the plunger of the gun. Be sure that the bearings are not overloaded; overloading will result in the grease oozing out of the end castings, being forced into the motor, or being thrown on other parts of the mechanism. After lubricating, run the motor for a few minutes and then wipe off any excess grease that has been forced out of the ends of the castings. Each time the gun is used for lubricating a motor bearing, the plunger should first be depressed slightly to make sure that grease will be delivered.

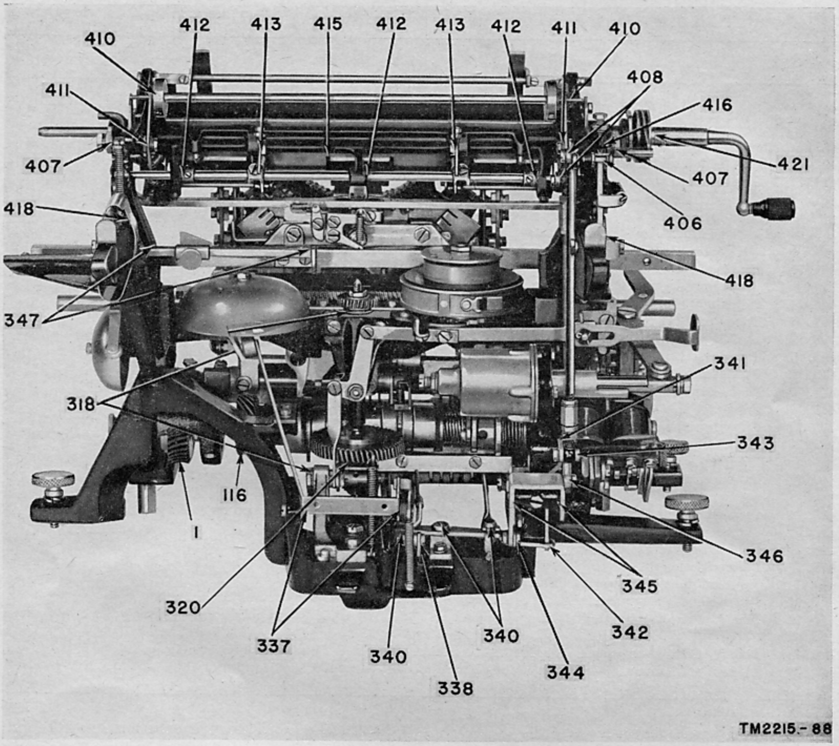

Figure 77. Rear of typing unit, lubrication points.

44. Painting and Rustproofing

When the finish on the table has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use #00 or #000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter components of the table and cause harmful internal shorting and grounding of circuits.

a. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the components and spray paint over the entire table.

b. Remove rust from the table by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

45. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fun-

gus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully described in TB SIG 75.

Section III. PREVENTIVE MAINTENANCE SERVICES

46. Definition and Importance of Preventive Maintenance

Preventive maintenance is a systematic series of operations performed periodically on equipment to maintain top efficiency in performance, to minimize unwanted interruptions in service, and to eliminate major break-downs. To understand what is meant by preventive maintenance it is necessary to distinguish it from trouble shooting and repair. The primary function of preventive maintenance is to prevent break-downs and the need for repair. On the other hand, the primary function of trouble shooting and repair is to locate and correct existing defects. Preventive maintenance is of utmost importance. The usefulness of the entire system of communication depends upon equipment being ready to operate at peak efficiency when needed.

47. Introduction to Preventive Maintenance Procedure

a. Preventive maintenance is divided into two classes: work, which can be completed while the teletypewriter remains in service, and work that requires that the teletypewriter be taken out of service.

b. The first class of work is limited to operations performed on the exterior of the teletypewriter, the typing unit cover, the table, and the rectifier power unit.

c. The second class of work includes operations that require removal of the following items from the table: the typing unit cover, typing unit, keyboard-transmitter, base, and rectifier power unit.

d. Detailed information on the individual test requirements and adjustments of complicated parts and mechanisms are not included in this section of the manual. The preventive maintenance checklist (par. 62) includes references to detailed instructions required when making adjustments during the preventive maintenance procedures.

e. Refer to paragraph 43 for lubrication and to paragraph 45 for weatherproofing instructions.

f. Preventive maintenance procedures for common classes of parts are grouped as follows:

Typing unit cover exterior.
Table.
Keyboard.
Cords, cables, and wiring.
Terminal boards and slip connections.
Keys and switches.
Rectifier power unit.

g. Detailed preventive maintenance instructions are arranged as follows:

Preparation for preventive maintenance (teletypewriter out of service).
Table.
Base.
Motor unit.
Typing unit (less type basket).
Type basket.
Keyboard-transmitter.
Rectifier power unit.

h. When worn, broken, or defective parts are found, repair or replace them. After all preventive maintenance work has been completed (including detailed lubrication procedure), reassemble the teletypewriter and make the following adjustments and tests:

(1) Motor speed.
(2) Rangefinder setting.
(3) Local operating tests.

Note. When any adjustment is made or changed, *always* check adjustment of related parts of mechanism.

48. Preventive Maintenance for Teletypewriter Exterior (Equipment in Service)

a. Typing Unit Cover.

(1) Inspect the typing unit cover. Look for dents, cracks, marred painted surfaces, rust, corrosion, broken glass, loose or missing screws, escutcheons, faulty hinges, and damaged metal flaps (over the polar-neutral key and rangefinder). See that the copyholder is in good condition.

(2) Tighten all loose screws, hinges, escutcheons, and the copyholder paper clip.

(3) Clean the outer surfaces of the typing unit cover with a piece of cheesecloth slightly moistened with water. To remove oil, grease, or gummy stains on the outer surface of the cover, moisten the cloth with a little solvent (SD). Remove rust spots from exposed metal surfaces by rubbing with an oily cloth. As soon as possible, clean and repaint the exposed metal surface.

b. Table.

(1) Inspect the table for breaks or cracks in the metal. Look for marred painted surfaces, missing or loose screws, and dust, dirt, or corrosion, especially at the front of the table and on the front shelf.

(2) Tighten all loose screws and other fastenings. If loose power receptacles, jack blocks, or terminal boards under the front of the table are found, tighten them (par. 146). See that the supports of the front shelf are secure. Make sure that the rubber foot at the bottom of each leg of the table is in place. Tighten the screws at the back of the table that hold the electrical service unit in place.

(3) Clean the outer or painted surfaces of the table, using cheesecloth and water, or solvent (SD) as stated in *a*(3) above. Use a suitable brush to clean out any dust and dirt which might have accumulated in the corners of the front shelf. Repaint exposed metal surfaces as soon as possible.

c. Keyboard.

(1) Inspect the keyboard. Look for cracked keylevers. Note that the keyboard frame is secure and is not cracked or broken.

(2) Tighten the two thumbscrews that hold the keyboard casting to the base (fig. 4). Note that the keytops are secure on each keylever.

(3) Clean the keytops, keyboard frame, space bar, and the top of the table immediately under the keyboard. Use a damp cloth to clean the keytops. Never use solvent (SD) on rubber keytops. Remove rust by rubbing with an oily rag. Clean and repaint exposed metal surfaces.

(4) Lubricate the keylever guide surfaces as directed in paragraph 43.

d. Rectifier Power Unit.

(1) *Make sure that power has been disconnected before touching this unit.* Inspect the exterior of the rectifier power unit. Look for loose screws and fastenings. See if the door can be fastened securely. Look for cracks and dents and distortion of the rectifier power unit cover. See that the cover fits securely over the electrical parts.

(2) To tighten cable and cord clamps and electrical connections, remove the protective cover of the rectifier power unit. Tighten the fastening screws that hold the cover in place and those that secure the door. If cords and cable appear to be loose, refer to paragraph 57.

(3) Clean the protective cover of the rectifier power unit as described in *a*(3) above.

49. Preparation for Preventive Maintenance Inspection (Equipment Out of Service)

a. For a thorough preventive maintenance inspection the teletypewriter must be taken out of service and partially disassembled as outlined in *b* below. Prepare a suitable work table or bench upon which to set the components after removal from the teletypewriter table. Spread several sheets of paper under and around the work table to catch small parts or hardware that may be dropped during disassembly of equipment.

b. Remove the equipment from service and disassemble it as follows:

(1) Disconnect the power from the teletypewriter. If power leads are connected directly to a power terminal board, open the service switch before disconnecting these leads. If there is no service switch, disconnect the power leads (using line-

man's gloves) at the terminals on power terminal board. Refer to paragraph 20.

Caution: Be careful not to short-circuit the power leads by allowing them to touch each other or any grounded part of the equipment. *Always* tape exposed ends of live conductors.

(2) Disconnect the power cords from the rectifier at the receptacles and the power connections in the front of the table.

(3) Disconnect the operating components by pulling the red and black plugs out of their respective jacks. Disconnect the signal lines at line terminals Nos. 7, 8, 9, and 10 at the line and battery terminal board of the table.

Note. Always tag each signal line as it is removed from a terminal, so as to indicate polarity, location at the line terminal board, and type of signal (neutral, polar, or polarential) characteristic of the related circuit.

(4) Remove the typing unit cover as follows:

(*a*) Remove the paper from the teletypewriter. Remove the platen crank.

(*b*) Lift off the typing unit cover and set it aside out of the way.

(5) Remove the following components in the order indicated:

(*a*) Remove the keyboard by loosening the thumbscrews that hold the assembly to the base (fig. 86). Set the entire assembly aside and protect it against dust and damage.

(*b*) Unscrew and remove the three large, flat, knurled screws that hold the typing unit to the base (fig. 4). Lift the typing unit off the base and set it upon a work table or bench so that it is supported by the hexagonal studs (fig. 14) on the bottom of the typing unit. Cover the typing unit and protect it against dust, dirt, or damage.

(*c*) Remove the relay (fig. 32) from the base. Set the relay aside where it cannot be damaged. Do not remove the relay cover unless servicing is necessary.

(*d*) Remove the mounting screws that hold the motor unit to the base. Lift off the motor unit (fig. 12) and replace the screws in the base so that they will not be lost. Set the motor unit aside and protect it so that the governor will not be disturbed. Protect the motor unit against dust and damage.

(*e*) Lift the base so that the cords and wiring at the right front corner can be pulled through the cut-out hole in the table top. Do not use force to pull the plugs at the ends of the cords through the cut-out hole.

(*f*) Lift the rectifier off its shelf at the front of the table. Place it where it will not be damaged or dropped. Protect it against entry of dust and dirt.

50. Preventive Maintenance for Teletypewriter Table

a. Top. Inspect the protective pad and the steel channels that hold the pad in place. Look for worn spots and cut or frayed edges on the pad. Examine the pad guides or molding. Locate broken, cracked, or bent edges and corroded or rusted places. Tighten all mounting screws. Tighten the rails or metal moldings that hold the protective pad in place, and restore them to their normal condition by carefully bending the edges. Brush away all dust and dirt and clean corroded places. Use an oily rag to remove rust spots. Clean and repaint exposed metal surfaces. Use a stream of clean dry air to blow out dust from between contacts and springs. If the protective pad on top of the table cannot be cleaned, replace it. To remove gummy, oily, or greasy spots from the table top, use cheesecloth moistened with solvent (SD). Brush out dust and dirt from the under surface of the table.

b. Ends and Front. Inspect the ends of the table. They are made of sheet steel and may be cracked or dented, or the paint may be marred and exposed surfaces rusted. Open and expose the interior of the electrical service assembly in the front of the table (drop the hinged cover by loosening two bottom screws). See that the line and test jacks are in good condition and that they operate normally.

c. Front of Table. Inspect the electrical outlets, electrical service assembly (opened), and other electrical connections. Look for loose mounting screws, dirt, dust, rust, or corrosion. Examine the mounting holes into which the screws are fastened. Note any bent, cracked, or broken

metal or bakelite receptacles or fittings. See that terminal boards are held in place securely. If any mold is noticed, burn a 50-watt lamp or other suitable heating unit inside the table until surfaces are thoroughly dry. Tighten all screws. If necessary, replace or tighten the signal or power line terminal boards and connections. Tighten the jack blocks, the electrical outlets, and the receptacles. Do not remove them to tighten conductors that terminate at these connection devices. Brush out all dust and dirt from the shelf upon which the rectifier power supply rests. Use a suitable brush or stream of clean dry air to clean out the compartment in which the line and power terminal boards are located. Blow all dust and dirt out of the compartment that holds the jacks and line resistors. See if jack springs and resistors require tightening. Clean away all corrosion and rust. Remove rust, then clean the surface and paint all exposed metal surfaces. If the table has been weatherproofed, apply the protective coating where it is necessary. Do not damage the weatherproof coating that protects the conductors which terminate at electrical receptacles, outlets, and jacks.

d. Back of Table. Brush out dust and dirt from the under surface of the table. Clean all surfaces as described in *a* above.

e. Adjustments. The only parts of the table that may require adjustment are:

(1) Electric power connections and contacts in power terminal boards, plugs, receptacles, and outlets.

(2) Electrical signal circuit contacts in line terminal boards and line jacks.

Note. Be sure to close the electrical service assembly cover.

51. Preventive Maintenance for Teletypewriter Base

a. Inspect the base for loose screws, cracked or chipped paint, broken or damaged metal parts, cracked or broken electrical contacts, and insulating materials. Adjust, repair, or replace fuse blocks, electrical outlets and electrical terminals and contacts as directed in paragraph 198.

b. Tighten all screws, nuts, and bolts of the base. See that the terminal boards, electrical outlets, and fuse block are securely in place. If spring contacts such as those that complete the electrical circuits to the typing unit, motor unit, keyboard-transmitter, etc., and the SEND REC BREAK contacts require tightening, refer to chapter 4. See that the corner mounting feet at the bottom of the base unit are tight and that the bottom plate is securely fastened in place.

c. Use a lint-free cloth or soft brush to clean the base. Use a stream of clean air to blow out dust and sand from inaccessible places. Use an oily rag to remove rust spots. Clean away all corrosion and any oil that may have dripped onto the base from the typing unit or motor unit. The bottom plate of the base may be removed, if necessary, to clean under the surface containing the keyboard, motor unit, and typing unit spring contacts. *Do not attempt to clean contact springs.* Clean and repaint all exposed metal surfaces. Renew the weatherproof coating, if necessary (par. 45). Clean dust from resistors and capacitors in the relay mounting. Clean only the outside cover of the relay unless the relay appears to be causing trouble, in which case adjust as directed in chapter 4.

d. The rails upon which the keyboard-transmitter slides onto the base, the surfaces upon which the typing unit rests, and certain other points may require lubrication. Refer to paragraph 43 for lubrication instructions for the base unit.

52. Preventive Maintenance for Motor Unit

a. The motor should turn freely, smoothly, and quietly when turned by hand and when under power. Check the motor unit for evidences of overheating, which may be indicated by discoloration or a smell of burned insulating material. Look for loose pinion-holding screw, loose governor (to shaft) holding screw, motor mounting screws, looseness of the target, and broken or bent governor bracket. See that the lamp, switch, and lamp housing are in good condition. If they are not in good condition, refer to paragraph 203.

b. Tighten the screws that hold the motor to the motor unit base plate. See that the governor-adjusting bracket, governor-adjusting lever, target lamp, and lamp housing are secure. Tighten the pinion on the motor shaft, if necessary. Tighten the target on the motor shaft. *Do not adjust the motor plate adjustment screw* (fig. 252).

c. Clean the exterior of the motor only. If the commutator appears to be marked or dirty, clean it as instructed in chapter 4. Remove all dust, dirt, grease, and corrosion from the outside of the

motor, external motor-governor contacts, and motor mounting plate. See that the governor is clean and the wires leading to the motor are intact and clean. If they are oil-soaked and require replacement, proceed as directed in paragraph 203. Clean and repaint all exposed metal surfaces.

d. Adjust the motor unit, governor bracket, and governor lever as directed in chapter 4. Adjust the motor alinement as instructed in paragraph 365. Make other adjustments of the motor unit in accordance with instruction in paragraphs 399 to 409.

e. Lubricate the motor unit in accordance with instructions in paragraph 43.

53. Preventive Maintenance for Typing Unit (Less Type-Bar Carriage)

Remove the type-bar carriage and place it aside where it will be protected from dust, dirt, and damage.

a. Inspect the typing unit for—

(1) Cracks or other damage to the frame casting.

(2) Loose, broken, or missing mounting screws.

(3) Bent, broken, or worn levers, vanes, rollers, bearings, shafts, and gears, and see that all parts move freely.

(4) Missing, broken, or distorted springs and spring posts.

(5) Binding, excessive wear, or damage to the main shaft and associated gears, bearings, cams, clutches, and springs.

b. Tighten loose screws, bolts, or nuts, *only if they are not a part of some adjustment.* If part of an adjustment, adjust only according to chapter 4.

c. Use a piece of clean cheesecloth (or other lint-free cloth) folded over a stick of wood of appropriate size to remove all grease and oil that have accumulated dust and dirt. Clean between the vanes, between the printing bail blades, between the function levers, and in other relatively hard-to-reach places. Be careful not to bend or distort any of the metal linkages. Use a clean cloth to remove oil or grease from all accessible surfaces. Do not permit dirt, grit, or other foreign matter to drop into bearings or on working surfaces. Wipe each bearing with a piece of clean cloth. Loosen the rangefinder retaining screws. Remove the left screws completely and slip the rangefinder off the remaining screw (with the slotted screw hole). Use a clean piece of cloth folded over a stick to remove oily deposits of dirt, dust, paper, lint, etc., from the outer surface of the selector magnet mechanism and rangefinder. Flush the selector mechanism by pouring a small amount of solvent (SD) between the separator plates. Repeat the flushing process as necessary. Use only about 1 tablespoonful of solvent each time. Do not take the selector mechanism apart unless the foreign material cannot be removed by flushing. Only well-qualified personnel will disassemble the selector mechanism. To remove the glaze and aid in eliminating paper slippage, wipe the platen surface with a piece of clean cheesecloth slightly dampened with solvent (SD).

Caution: Use dry-cleaning fluid sparingly on rubber platens. Excessive amounts of dry-cleaning fluid will swell the rubber and cause it to split. This makes the platen unfit for further use.

d. Make only those adjustments directed in chapter 4, unless trouble or defects are found. These adjustments are to be made only by thoroughly experienced personnel who are equipped with the necessary tools, gages, spring scales, etc. The exact requirements for these adjustments, and others if necessary, are given in chapter 4.

e. Lubrication instructions for the typing unit are given in paragraph 43.

54. Preventive Maintenance for Type-Bar Carriage

a. Inspect the type-bar carriage for the following:

(1) Missing mounting screws, bolts, and loose parts.

(2) The frame for cracks or other damage.

(3) Each bell crank, code bar, and type bar to determine that parts are not bent or distorted, and that they are in good condition and operate freely.

(4) Each type bar for missing or damaged type pallets.

(5) Levers, gears, shafts, and bearings for signs of excessive wear or damage, loose parts, or excessive oil or grease.

(6) Missing, broken, or distorted springs.

b. Tighten all loose screws, bolts, and parts other than those that are adjustments. For adjustments, refer to chapter 4.

c. Prepare a pad of cheesecloth large enough to cover an area about 8 inches square. Insert this pad between the type bars and the backstop so as to catch dirt and cleaning fluid (solvent (SD)).

(1) Wipe the face of the type pallets with a piece of cheesecloth moistened in solvent (SD). *Do not bend the type bars.*

(2) After the pallets are dry, brush them with a clean, dry typewriter brush.

(3) Repeat the cleaning process as necessary. Tilt the type-bar carriage and flush the solvent through the segment slots.

Caution: Flushing with dry-cleaning fluid destroys existing lubrication. Relubricate the parts after they are thoroughly dry.

d. Refer to chapter 4 for necessary adjustments. Adjust the type-bar carriage as required. Adjust the ribbon mechanism.

e. Refer to paragraph 43 for lubrication instructions.

55. Preventive Maintenance for Keyboard and Transmitter

a. Inspect the keyboard-transmitter for the following:

(1) Cracks or other damage to the frame and the mechanical linkages that connect the transmitter mechanism to the keyboard assembly.

(2) Loose, missing or broken screws, nuts, bolts, fastenings, and electrical connections. Frayed or broken wire insulation and oil-soaked wiring or insulation.

(3) Levers, pawls, latches, selector bars, springs, bearings, etc. See that all parts move freely and are not damaged or broken.

(4) Missing, broken, or illegible keytops.

(5) Missing, broken, or distorted springs.

(6) Damaged or broken drive-shaft gear and associated gear clutch and bearings for binding.

(7) Transmitting contact assembly for worn, burned, or dirty contacts and insulation.

b. Do not tighten parts which require clearance or tension adjustments. For tightening electrical connections, refer to chapter 4. Tighten all screws and bolts that are *not* part of an adjustment.

c. Clean the keyboard and transmitter as follows:

(1) Clean the keytops with a piece of cloth moistened in water.

(2) Blow out or brush away dust and debris that may have accumulated in the transmitter mechanism and around the mechanical levers connecting it to the keyboard.

(3) Burnish or file the contacts if dirty, built-up, or pitted.

(4) For complete disassembly, repair, or adjustment instructions, refer to chapter 4. At that time normally inaccessible points of the equipment may be reached for cleaning.

d. For adjustment of the transmitter and keyboard, refer to chapter 4.

e. For lubrication data refer to paragraph 43. Make certain that the transmitter shaft is well lubricated and turns freely.

56. Preventive Maintenance for Rectifier Power Unit

Place the rectifier power unit on a table or bench. Lift off the cover.

a. Inspect for loose connections, damaged or broken parts, and defective or burned-out wiring. Look for evidence of overheating, noting whether the transformer, filter reactor, and the selenium rectifying stack appear to be discolored. Check for corroded or burned-out fuses. *Remove* any strap used to strap a blown fuse. Look for loose cable or cord connections and for loose connections at the tap-and-fuse cord panels.

b. Tighten all loose screws, bolts, nuts, cable clamps, etc. See that the terminal screws on the tap, fuse, and cord panels are tight. *Do not* tighten the drawbolt of a stack type rectifier unit. Solder any loose or broken connections. Bend the prongs of power plugs to insure a tight fit in the sockets.

c. Use a suitable brush, a stream of clean dry air, and cheesecloth to clean away dust, dirt, and oily or gummy deposits. To remove stains or dirt that cannot be removed with a cloth dampened in water, use a cloth dampened in a small quantity of solvent (SD). Use (only if absolutely necessary) a small brush such as a camel's-hair touch-up brush to clean between rectifier stack disks. Remove all rust spots with an oily rag. Repaint all exposed

metal surfaces, and arrange to restore weatherproof coatings as directed in paragraph 45. To remove corrosion from fuses or their holders use No. 000 sandpaper or crocus cloth and wipe clean with a dry cloth.

57. Preventive Maintenance for Cords, Cables, and Wiring

Preventive maintenance procedure covered in this paragraph applies to the wiring located in the following items: the base, the typing unit, the keyboard-transmitter, the motor unit, and the rectifier power unit. Wires which are tied together or cabled are sometimes called wiring harness. Wiring on equipment which is operated in all kinds of weather and moved over many kinds of terrain is subjected to severe punishment; therefore, check the wire at all times.

a. Inspect for cracked or deteriorated insulation, frayed or cut insulation at connecting or supporting points, and strain due to improper placement. Look for kinks and poor supporting means.

b. Tighten loose fasteners, cable clamps, and wiring connections. Be sure to tighten ground connections. A loose or inefficient ground may interfere with operation of the equipment in a manner difficult to trace, and may also nullify lightning protection for equipment and personnel. Repair loose or broken soldered connections.

c. Clean connector straps when necessary. To clean a connector strap, remove it and scrub it with a clean brush dipped in solvent (SD). Dry it thoroughly with a cloth. If connectors are corroded, clean them with No. 0000 sandpaper. The contact surface of a connector should always be clean and bright. Remove corrosion, rust, dirt, and dust from ground connections. Make sure that the outer insulating cover of cords and cables is wiped clean. If necessary, use a clean cloth moistened in water. Never use oil or solvent (SD) on rubber insulation. If the weatherproof coating of fabric-covered wire requires renewal or repair, refer to paragraph 45. Clean plugs with polish, metal, paste.

d. Adjustment of wiring is normally confined to arranging it so that it does not interfere with operation of mechanical parts. It may be necessary to resolder connections or to replace wiring or conductors when they become worn or damaged.

58. Preventive Maintenance for Terminal Boards and Slip Connectors

Terminal boards used as receiving, connecting, and distributing points for electrical circuits are usually made of a strip of insulating material and one or more types of electrical connectors. These devices may be either solder or screw terminals, contact springs, or contact lugs. They require little preventive maintenance unless the wiring is changed.

a. Inspect terminal boards for cracks, breakage, dirt, and loose connecting or mounting screws. Examine the connections for mechanical defects (broken or stripped screws and threads), dirt, grease, and corrosion.

b. Tighten loose screws, lugs, and mounting bolts. Use tools of the correct size. Do not strip threads by exerting too much force. Solder loose or broken connections.

c. Using a clean dry brush, clean the terminal boards. Wipe off excess moisture with a clean dry cloth. When necessary, the insulation strips may be cleaned with a cloth moistened in solvent (SD). Wipe thoroughly and remove all lint. Remove and clean corroded or loose connections with a piece of No. 0000 sandpaper or crocus cloth. Use carbon tetrachloride to clean electrical contact surfaces of all connecting devices.

d. Adjust the spring tension of contact springs when necessary. To increase spring tension, take hold of the spring near its anchor point with a spring bender or a pair of duck-billed pliers. Twist the tool slightly in the direction in which it is desired to increase the tension, and move the tool continuously along the slight bow (or curvature) in the spring. Test the action of the spring after each adjustment. Be careful to keep all soldered connections intact. If resoldering is necessary, refer to chapter 4. *Never* lubricate an electrical contact.

59. Preventive Maintenance for Keys and Switches

a. All keys and switches on the teletypewriters are grouped as a common class. No specific information is provided for any particular key or switch.

b. Inspect the mechanical action of each key and switch. Look for dirt or corrosion. Operate each key or switch to see that it moves freely.

Note the amount of spring tension and any excessive looseness.

c. Tighten loose screw lugs and mounting bolts. Remove loose connections which are dirty or corroded, and clean them before tightening or soldering. Tighten switch connections and repair broken solder connections.

d. Wipe off excess moisture. Clean the exterior surfaces of keys and switches with a stiff brush moistened in solvent (SD). *Never apply* solvent (SD) to rubber keytops. Clean corroded and dirty contacts when necessary. Use a burnishing tool to polish contact surfaces after cleaning with abrasives such as No. 0000 sandpaper, crocus cloth, or a contact file. If contacts are pitted or burned, use the contact file to restore the surfaces and then polish with a burnishing tool.

e. Never lubricate an electrical contact surface. If mechanical linkages require lubrication, refer to paragraph 43 for the necessary instruction.

60. Preventive Maintenance Schedules and Records

a. A chart should be prepared showing the various teletypewriter sets in the installation, the average number of hours of operation daily, the dates the routines are scheduled, the dates the routines are completed, and by whom completed. Figure 78 shows a typical schedule. The schedule should be based upon accurate information and should be revised from time to time as conditions change. The record form used may cover time intervals of 1 month, 2 months, or any other interval desired by the officer in charge of the installation. The recommended time intervals for equipment routines are—

(1) Equipment in operation 12 to 24 hours daily—routine every 10 days.

(2) Equipment in operation 8 to 12 hours daily—routine every 15 days.

SHEET NO. 4
YEAR 1945

PREVENTIVE MAINTENANCE ROUTINE SCHE

TYPE OF EQUIPMENT AND SET NO.			APRIL			MAY			JUNE		
MODEL 15 TELETYPEWRITER SET NO. 1		DATE SCHEDULED	10	20	30	10	20	30	10	20	30
		DATE COMPLETED	9	20	30						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	24	COMPLETED BY	GH	JJ	JJ						
MODEL 15 TELETYPEWRITER SET NO. 2		DATE SCHEDULED	--	15	30	--	15	30	--	15	30
		DATE COMPLETED	—	14	31						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	12	COMPLETED BY		MK	MK						
MODEL 19 TELETYPEWRITER SET NO. 1		DATE SCHEDULED	10	20	30	10	20	30	10	20	3
		DATE COMPLETED	10	21	30						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	24	COMPLETED BY	GH	JJ	JJ						
MODEL 19 TELETYPEWRITER SET NO. 2		DATE SCHEDULED	--	15	30	--	15	30	--	15	
		DATE COMPLETED	—	15	31						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	12	COMPLETED BY		JJ	MK						
MODEL 15 TELETYPEWRITER SET NO. 3		DATE SCHEDULED	--	--	30	--	--	30	--	--	
		DATE COMPLETED	—	—	29						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	8	COMPLETED BY			MK						

24 HOURS DAILY OPERATION

12 HOURS DAILY OPERATION

8 HOURS DAILY OPERATION

TL 54494S

Figure 78. Typical preventive maintenance routine schedule.

(3) Equipment in operation 8 hours or less daily—routine every 30 days.

b. The above time intervals for equipment routines are based on operating conditions such as are found in the average business office in the continental United States. When equipment is being operated in localities where there are extreme temperatures, excess moisture, dust, dirt, or sand, or other adverse conditions, the routine schedules should be established on whatever intervals are necessary to keep the equipment in operating condition.

61. Use of Preventive Maintenance Checklist

Paragraph 62 is a preventive maintenance checklist for Teletypewriters TT–5/FG and TT–6/FG. Preventive maintenance procedures which operators may perform are indicated in *a* below. Preventive maintenance procedures described in paragraph 62*b* are those which only more qualified maintenance personnel perform. The time intervals shown on the checklist may be reduced at any time by the local commanding officer. However, for best performance of the equipment, the operations must be performed at least as frequently as called for in the checklist.

62. Preventive Maintenance Checklist for Teletypewriters TT–5/FG and TT–6/FG

a. Preventive Maintenance by Operators.

Item No.	What to check	When to check	How to check
1	Teletypewriter exterior.	Daily	Inspect for damaged places, chipped paint, dirt, dust, rust, corrosion, and loose or missing screws. Tighten all loose screws. Clean with clean dry cloth slightly moistened with solvent (SD) to remove oil, grease, or foreign matter. Wipe with dry cloth.
2	Rectifier	Daily	Check for cleanliness. Clean with clean dry cloth in same manner that item No. 1 is cleaned.
3	Motor speed	Daily	Check and adjust motor speed (pars. 22*b* and 208).

b. Preventive Maintenance by Field Maintenance Personnel.

Item No.	What to check	When to check*	How to check
1	Typing unit (less type-bar carriage).	X	*a.* Clean all mechanical parts; inspect and adjust range-finder setting (pars. 22*e* and 285), the armature trip-off eccentric screw adjustment (par. 282), and the selector armature end play and locking wedge (pars. 263 and 267). Inspect, clean, and adjust the magnet bracket (par. 284), the carriage-return latch-bar latch (par. 337), and the carriage-return lock-bar latch eccentric screw (par. 338). *b.* Inspect spring posts (2½-pound (or more) tension). *c.* Inspect the function-bail cam roller, the function-lever bail roller pivot bearings, the printing-bail cam roller, and the cam roller pivot bearings. *d.* Inspect, clean, and adjust relays (pars. 414 through 418). *e.* Inspect and adjust the platen assembly (pars. 194 and 287); the dash pot (pars. 346 and 377); the left-hand margin adjustment (pars. 377 and 369). *f.* Inspect, clean, and adjust the motor-stop contacts (par. 277) and the slip connections (pars. 198 and 413). *g.* Lubricate the entire mechanism (par. 43).
2	Type-bar carriage.	X	*a.* Inspect and clean all mechanical parts (par. 163). *b.* Inspect and adjust the ribbon mechanism; check the type-bar back stop (par. 232). *c.* Lubricate the entire mechanism (par. 43).
3	Keyboard	X	*a.* Clean all mechanical parts (par. 163). *b.* Inspect, clean, and adjust the transmitting contacts (par. 382).

b. Preventive Maintenance by Field Maintenance Personnel—Continued

Item No.	What to check	When to check*	How to check
	Keyboard—Continued		*c.* Inspect, tighten, and clean the terminal board and the wiring (par. 163). *d.* Inspect and clean the polar-neutral key (par. 163). *e.* Lubricate the entire mechanism (par. 43).
4	Base	X	*a.* Inspect and clean all mechanical parts (par. 163). *b.* Inspect, tighten, and clean terminal boards and clip connections (par. 163) and cords, wiring, and plugs (par. 163). *c.* Clean and adjust the send-receive-break mechanism (par. 360). *d.* Inspect and clean the motor switch (par. 163). *e.* Lubricate the entire mechanism (par. 43)
5	Motor unit	X	*a.* Clean the exterior (par. 163). *b.* Check general over-all condition (par. 167). *c.* Inspect and tighten the motor pinion gear. *d.* Inspect and clean the armature commutator, brushes, and brush holders (par. 169). *e.* Inspect and clean the governor (pars. 179 and 181). *f.* Inspect, tighten, and clean the wiring and the light switch. *g.* Lubricate the entire motor unit (par. 43).
6	Table	X	Inspect, tighten, and clean the entire table, especially terminal boards, switches, wiring, and jacks (par. 163).
7	Rectifier	X	*a.* Clean the entire rectifier (par. 163). *b.* Inspect, tighten, and clean cords and wiring, and the rectifier stacks. *c.* Inspect, tighten, clean, and adjust the tap-changing panel (par. 428). *d.* Check fuse (pars. 146 and 163).

* X indicates when operations are to be performed and is determined by average hours of use as follows:

	Normal temperatures	Tropical temperatures
Up to 8 hours per day	Every 30 days	Every 15 days.
8 to 12 hours per day	Every 15 days	Every 10 days.
12 to 24 hours per day	Every 10 days	Every 7 days.

63. Trouble-Shooting on Organizational Maintenance Level

Trouble-shooting on the organizational maintenance level requires that trouble be traced to the faulty component as quickly as possible. It must then be determined whether the component can be repaired on the organizational level or must be sent to a field repair shop. Within the scope of the personnel and tools available, follow the trouble-shooting and repair instructions contained in chapter 4.

CHAPTER 4

FIELD MAINTENANCE INSTRUCTIONS

Section I. GENERAL REPAIR PROCEDURE

64. Outline of Repair and Adjustment Procedure

Service failures can be kept to a minimum by careful handling of equipment during installation, by completing preventive maintenance as specified in chapter 3, and by thoroughly investigating and correcting all troubles which are encountered. When service faults are discovered, a definite plan of corrective maintenance procedure will reduce both the time the equipment is inoperative and the amount of work required to complete the repairs. Section II includes a complete explanation of the purpose and operation of the various parts and circuits. An understanding of how the various mechanisms function will assist greatly in determining when the equipment is operating correctly, when it requires repairs, and when repairs are required whether it will be more practical to replace a part or to make the repair.

65. Trouble Locating

Section IV describes methods of isolating and locating different troubles. It also provides step-by-step analysis procedures in the form of trouble analysis charts.

a. TOOLS AND TEST EQUIPMENT. Paragraphs 37 and 38 describe the tools and test equipment normally required. With these items, all of the clearances, spring tensions, speed of rotation, and other adjustments necessary to determine that the entire teletypewriter is functioning properly, may be checked.

b. REPAIR AND REPLACEMENT. This chapter furnishes recommended procedures for the repair and replacement of those parts and units which experience the most wear. Only qualified and authorized personnel should attempt repair and replacement.

c. REQUIREMENTS AND ADJUSTMENT. This chapter furnishes all the test requirements and adjustment values required to make a complete check and adjustment of all teletypewriter mechanisms.

Section II. DETAILED FUNCTIONING OF EQUIPMENT

66. General Theory of Operation

a. GENERAL. Teletypewriters are motor-driven electromechanical devices that can interchange typewritten messages between two or more points connected by appropriate communication channels. Basically, each teletypewriter converts mechanical motion into electrical impulses when transmitting. When receiving, they convert electrical impulses into mechanical motion. The material in this section of the manual discusses the sequence of mechanical operations of the transmitting equipment that results in the transmission of electrical impulses, and the final mechanical action at the receiving teletypewriter necessary for the typing of messages. The components discussed in this section are the keyboard-transmitter, the typing unit, the base unit, the table, the rectifier power unit, and the motor unit which provides mechanical power for the other components of the equipment.

b. ELECTRICAL.

(1) *Power circuits.* The power circuits of Teletypewriters TT–5/FG and TT–6/FG consist of the incoming power lines, wiring, switches, fusing devices, receptacles, and outlets. In addition, the base upon which the motor unit is mounted contains

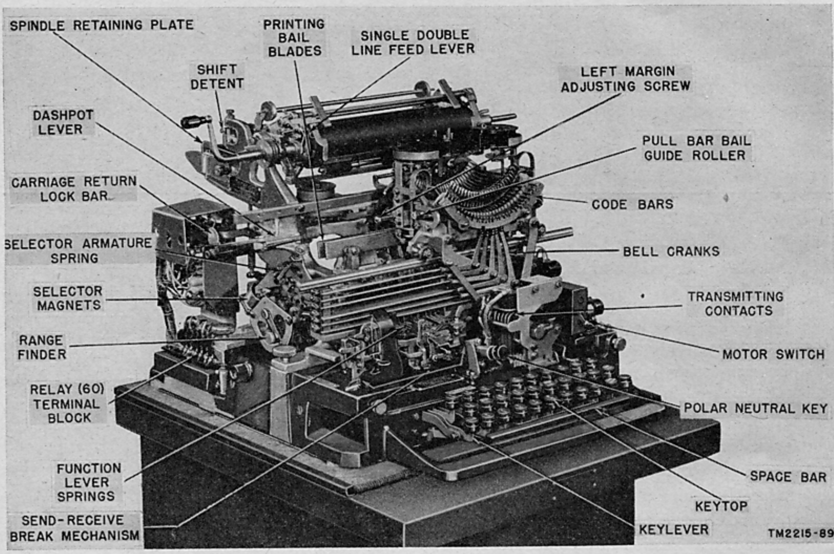

Figure 79. Teletypewriter, assembled, less cover.

wiring and slip connections by which power is brought to the motor unit. The power circuits are discussed in paragraphs 108 through 120. The rectifier power unit is discussed in paragraph 120.

(2) *Signal circuits.* The incoming signal lines, as well as the conductors for the send circuits, are completed by means of the line terminal boards at the table. The signal line jacks (fig. 136) are used to connect the typing unit and keyboard-transmitter to the line. Signal circuits of Teletypewriters TT–5/FG and TT–6/FG are arranged so that the transmitting contacts of the keyboard-transmitter direct their signals to the selector magnets of the teletypewriters with which they communicate. The local selector magnet (through the polar line relay) also receives transmission from both the remote and local transmitting contacts, except when the equipment is arranged for full-duplex operation.

(3) *Local circuits.* The local circuits of these teletypewriters are those by which the selector magnet and associated mechanism of the typing unit are energized. The local circuits are shown in figures 143, 155, and 283. Figure 150 shows the arrangement of the terminal boards on the base which complete the power and signal circuits to the various assemblies and operating components. A local test circuit also is provided. The line cord plugs may be plugged into the test jacks (fig. 136) so as to connect the operating components of these teletypewriters in this circuit. Line current adjustment for the local test circuit is provided by the 2,500-ohm resistor (fig. 151). The other resistor (2,000-ohm) shown in figure 151 is used when these teletypewriters supply current to the line.

c. Mechanical. The sequence of mechanical operations that are performed when Teletypewriters TT–5/FG and TT–6/FG are operated is

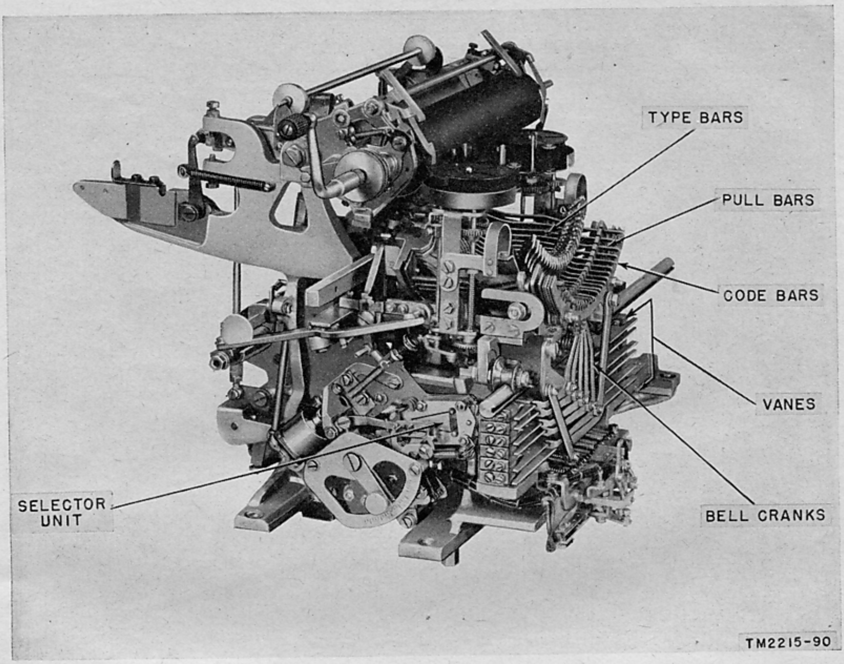

Figure 80. Typing unit with receiving mechanism, left front view.

described in the following paragraphs. Adjustment data for the mechanical assemblies appears in section VII of this chapter.

67. Motor Unit
(fig. 81)

a. Description and Purpose. The motor unit is an assembly mounted upon a base plate and comprises a motor with a governor and rotating target, and a lamp and lamp bracket. The lamp is used to illuminate the target during adjustment of the motor speed. The motor is series-wound and operates on 50/60-cycle ac. Mechanical power for the typing unit is provided by gearing it to the shaft of the motor. The motor mounting plate may be moved laterally for proper horizontal alinement with the main shaft gear, and a motor adjusting screw provides for proper vertical alinement. The motor unit is shown in place on the base unit (fig. 81).

b. Operation. The motor operates continuously at 2,100 rpm. Power for the motor is provided by connections on the cord panel of the rectifier power unit. The motor speed is adjusted by means of the governor. Proper speed is determined with the speed indicator and target.

68. Governor

a. Description and Purpose. The governor (fig. 81) is attached to the end of the motor shaft opposite the shaft upon which the motor pinion is fastened. The governor resembles a flywheel and has a series of white and black spots painted on its outer rim. The alternate black and white segments constitute the target by which correct speed is determined with the speed indicator. The

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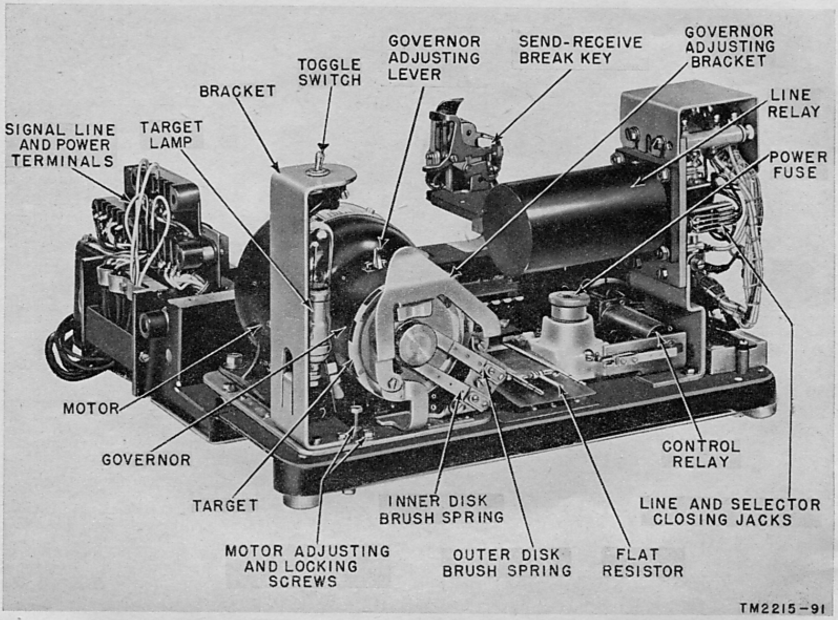

Figure 81. Motor unit mounted on base.

speed-adjusting wheel extends through the governor cover. It is turned by means of the governor-adjusting bracket (fig. 83) and governor-adjusting lever. This governor and an associated resistor control the speed of the motor. The resistor is connected across the governor contacts.

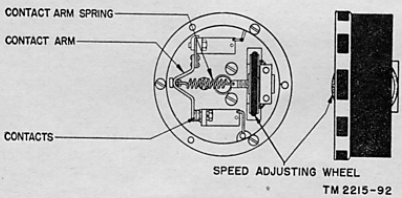

Figure 82. View of governor.

b. Operation.

(1) The governor contacts are opened when centrifugal force enables the contact arm to overcome the tension exerted upon it by the contact arm spring (fig. 82). When the contacts open, the resistor is connected in series with the motor windings. The total voltage applied to the

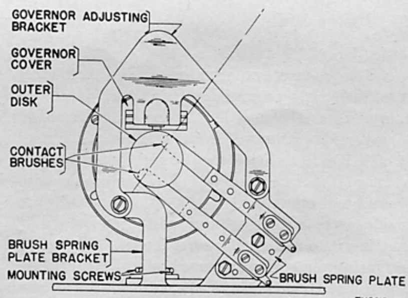

Figure 83. Governor-adjusting bracket assembly.

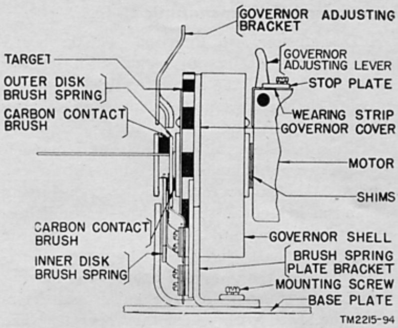

Figure 84. Motor governor, side view.

motor windings is now reduced by the voltage drop across the resistor, and the motor slows down.

(2) When the governor contacts close, the resistor is short-circuited and the full value of the motor voltage is applied to the motor windings, thus increasing the motor speed.

(3) The speeds at which the governor contacts open and close are controlled by the amount of tension exerted by the contact arm spring. Turning the speed-adjusting wheel (to which the spring is fastened) will increase or decrease the tension of the spring.

69. Main Shaft

a. Description and Purpose. The main shaft (fig. 85) is mounted upon, and extends across, the typing unit. On it is an assembly of gears, bearings, cams, and clutches arranged to distribute power to the various mechanically operated parts of the teletypewriter. Power is supplied to the shaft by gearing to the motor unit. The speed of rotation and the timing of the various cam actions in both the keyboard-transmitter and typing unit are, therefore, controlled by the speed (in rpm) of the motor unit.

b. Operation. When the motor is operating, the main shaft revolves because the main shaft gear (fig. 85) is meshed with the motor pinion. Power is then distributed by the shaft to the vari-

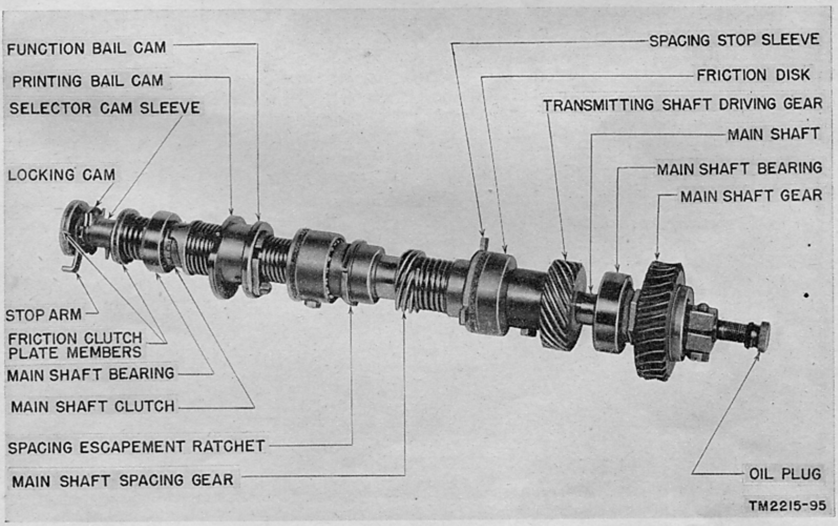

Figure 85. Main shaft.

ous parts of the machine through clutches, cams, and gears (fig. 85). The selector cam sleeve, fitted over the left end of the main shaft, delivers power to the selector unit. This is accomplished through two friction clutches, each composed of two steel disks separated by a felt washer. Operation of the main shaft clutch under control of the selector unit causes the function-bail cam and the printing-bail cam to rotate with the main shaft. The function-bail cam and the printing-bail cam, in turn, operate the function bail and the printing bail in the typing unit. These, in turn, furnish the direct power for the function or printed character previously selected by the selector unit. The spacing gear on the main shaft, meshing with the spacing shaft gear in the typing unit transmits power to the spacing mechanism discussed in paragraph 88. The transmitting-shaft driving gear supplies power to the transmitting shaft of the keyboard-transmitter.

70. Keyboard (Transmitting Unit)

a. Description and Purpose. The keyboard transmitting unit (fig. 86) includes the sending contacts and all of the associated mechanism required to change the action of depressing a typing key into a particular group of five impulses (marking, spacing, or combinations thereof), preceded by a start impulse and followed by a stop impulse. The power to rotate the transmitting mechanism is secured through the transmitting-shaft gear (fig. 86) meshed with the driving gear on the main shaft (fig. 85). The motor, therefore, furnishes the power to operate the moving parts of the transmitting mechanism and determines the speed with which they operate. The purpose and operating action of the transmitting-cam sleeve, selector bars, universal bar, vertical locking levers, start-stop and locking cam, and space repeat feature are described in separate paragraphs of this section.

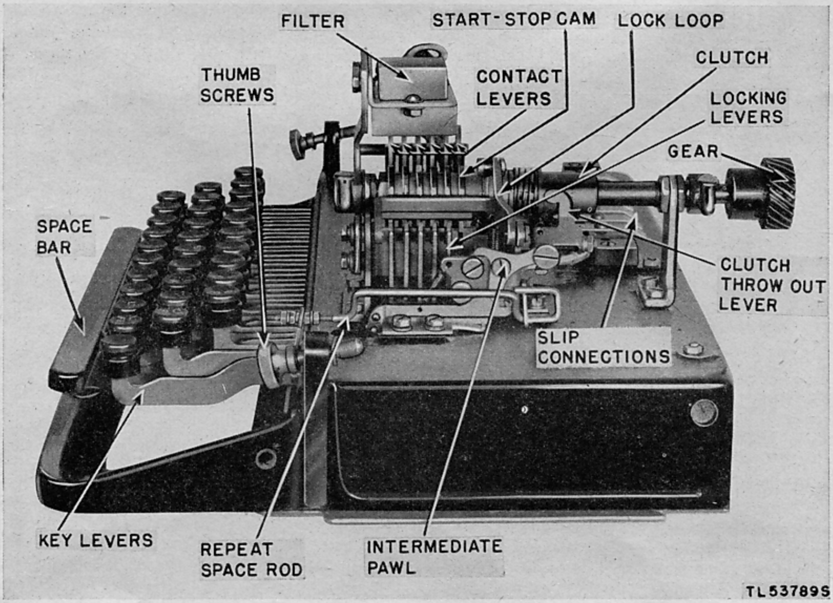

Figure 86. Teletypewriter keyboard.

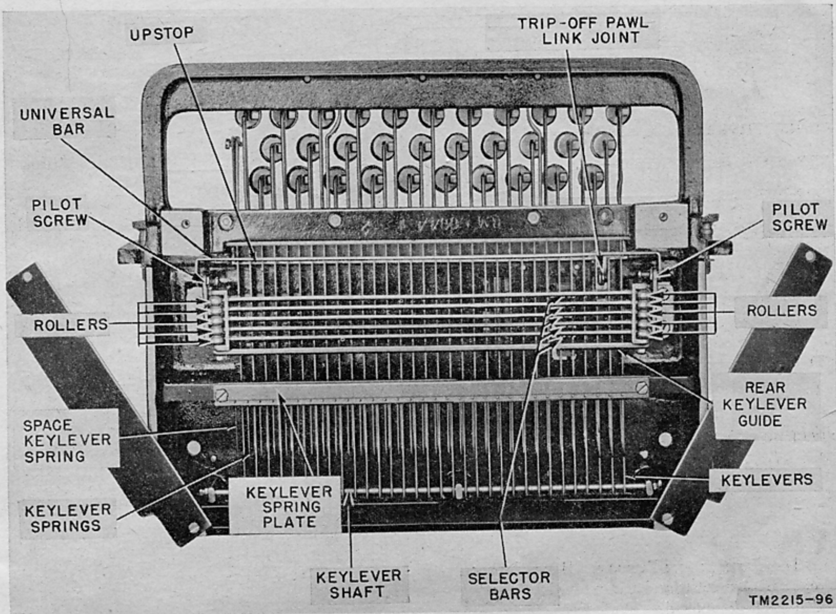

Figure 87. Keyboard, bottom view.

b. Operation. The transmitting cams normally are held stationary because the clutch members (driven and driving on the transmitting shaft) are held apart by the clutch throw-out lever. When either a key or the space bar is depressed, the driven member of the clutch moves into mesh with the driving member, causing the transmitting cams to revolve and thereby open and close the sending contacts in accordance with the code arrangement selected by the key or the space bar. At the end of the revolution, the driven member of the clutch is disengaged by the clutch throw-out lever and the transmitting cams stop until the next key or the space bar is depressed (fig. 88).

71. Transmitting-Cam Sleeve (Cylinder)

a. Description and Purpose. The seven cams in the keyboard transmitting unit are arranged as a single cam sleeve mounted on the transmitting shaft (C, fig. 89). Each cam is circular in shape and six of the cams have notches which receive extensions on the related contact levers. The seventh cam, or the lock-loop cam, has a projection which controls the movement of the lock loop. The driven clutch member is slipped over the transmitting shaft and is connected by sliding members so that it can engage with the driving clutch member. When engaged, the driving clutch member furnishes the necessary power to resolve the transmitting-cam sleeve. The design and mounting of the cams is such that the start, marking, spacing, and stop impulses transmitted by the sending contacts are of the desired length.

b. Operation. When the depression of a key or the space bar engages the clutch, the transmitting-cam sleeve immediately starts to revolve. This forces the individual cams, one after another, to operate the sending contacts riding on the related cams.

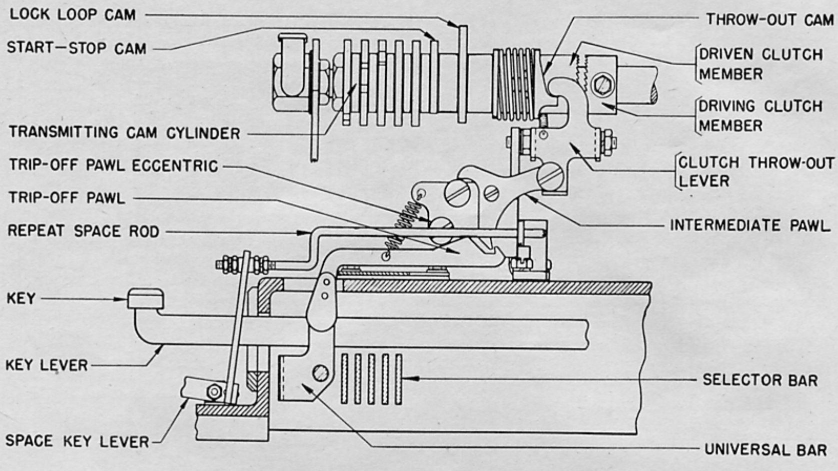

Figure 88. Cross-section of keyboard.

72. Selector Bars

a. Description and Purpose. Beneath the key-levers are five selector bars extending across the width of the keyboard. The selector bars are provided with saw-tooth notches (fig. 89) shaped according to the requirements of the signaling code. These bars rest on rollers and are guided at each end so that they may be easily moved endwise to engage and position the vertical locking levers.

b. Operation. When either a key or the space bar is depressed, the selected keylever strikes the slanting sides of the selector bar notches. The downward pressure on these saw-tooth notches moves the selector bars either to the right or to the left. Each selector bar engages a vertical locking lever near its right end and positions the lever to correspond with the code impulse to be transmitted.

73. Universal Bar

a. Description and Purpose. The universal bar (fig. 88) is mounted on pivots and extends horizontally across the bottom of the keyboard unit where all keys and the space bar will strike it when they are depressed. It is connected through the trip-off pawl to the clutch throw-out lever.

b. Operation. When any key or the space bar is depressed, in addition to setting the selector bars by moving them to the right or the left as described in paragraph 72, it also causes the universal bar to rotate on its pivots in such a manner that the trip-off pawl operates the intermediate pawl. This releases the clutch throw-out lever, and permits the transmitting cam sleeve (C, fig. 89) to start turning.

74. Vertical Locking Levers

a. Description and Purpose. Each of the five vertical locking levers is mounted with their lower ends firmly engaging a recess in the right end of a selector bar (fig. 89). The vertical locking levers are designed to control the movement of associated contact levers in a manner which permits the contacts to close when the contact levers are in one position and prevents them from closing when they are in the opposite position.

b. Operation. When the selector bar moves the upper end of the locking lever to the left for a spacing interval, the locking lever engages the contact lever and prevents the contact lever from rising into the indent of the turning cam and holds the circuit open for that impulse (A, fig. 89).

When the selector bar moves the locking lever to the right for a marking impulse, the locking lever does not interfere with the movement of the contact lever (B, fig. 89). Then, as the cam turns, the contact lever rides on the surface of the cam, rises into the indent, and the contact lever closes its contact, sending out a marking impulse. As the five transmitting cams turn, the units (elements), either marking impulses or spacing intervals or impulses, are transmitted in succession.

75. Start-Stop Cam

a. Description and Purpose. The start-stop cam (fig. 88) has the same general appearance as the other cams, and controls the sixth contact lever which opens and closes a contact to produce both the start and stop impulses.

b. Operation. The start-stop contact is opened at the beginning of each revolution of the cam shaft to transmit the start (spacing) impulse and is held open during the transmission of the five selecting impulses. After the fifth impulse has been transmitted, the start-stop contact closes and sends the stop (marking) impulse to the line. The contact remains closed until a key or the space bar is depressed and the transmitting cycle is started again.

76. Lock-Loop Cam

a. Description and Purpose. The lock-loop cam (C, fig. 89) is slightly larger than the other cams and is located on the end of the transmitting-cam sleeve nearest the clutch. This cam and the associated lock loop control the keyboard locking levers in such a manner that only one selection can be made at a time (for and during the course of a cycle or revolution).

b. Operation. As the transmitting-cam sleeve completes a revolution, the lock-loop cam disengages the lock loop from the locking levers, and

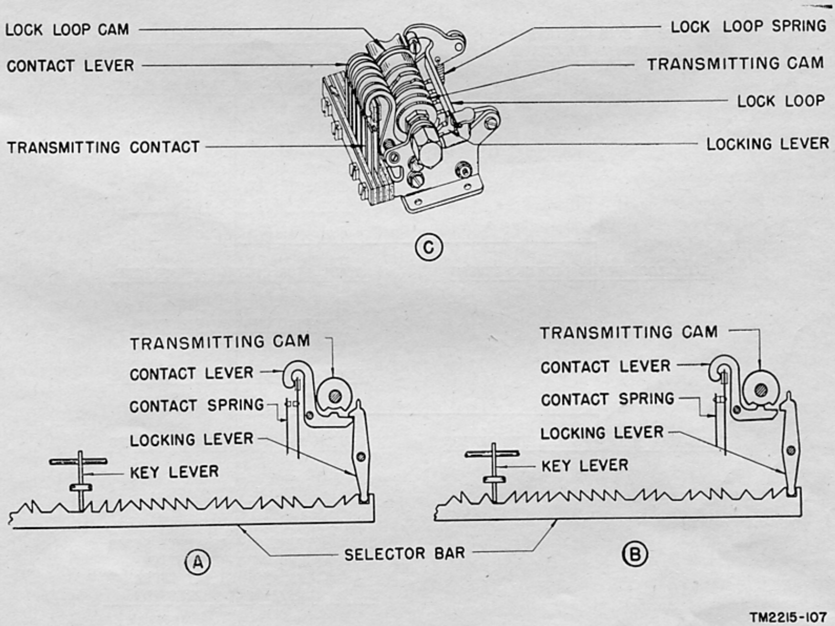

Figure 89. Vertical locking lever.

the keys and space bar are operated to set up a new selection. As soon as the selection is completed and the transmitting-cam sleeve starts turning, the lock-loop cam moves and this allows the lock-loop spring to move the lock loop to its down position. This holds the locking levers in position while the impulses are being transmitted.

77. Sequence Chart for Keyboard Functioning

Figure 90 is a chart showing the sequence of operation for the parts and subassemblies of the keyboard transmitting unit as described in preceding paragraphs of this section. A study of it will aid in following sequences of descriptions in subsequent paragraphs in this section.

78. Space Repeat

a. Description and Purpose. The keyboard is equipped with a space-repeat device which permits the transmission of continuous spaces as long as the space bar is depressed. The space-repeat rod is the connecting link between the space bar and the intermediate pawl.

b. Operation. When the space bar is depressed, a space-repeat rod (fig. 88), which is connected to the keylever extension, will rotate the

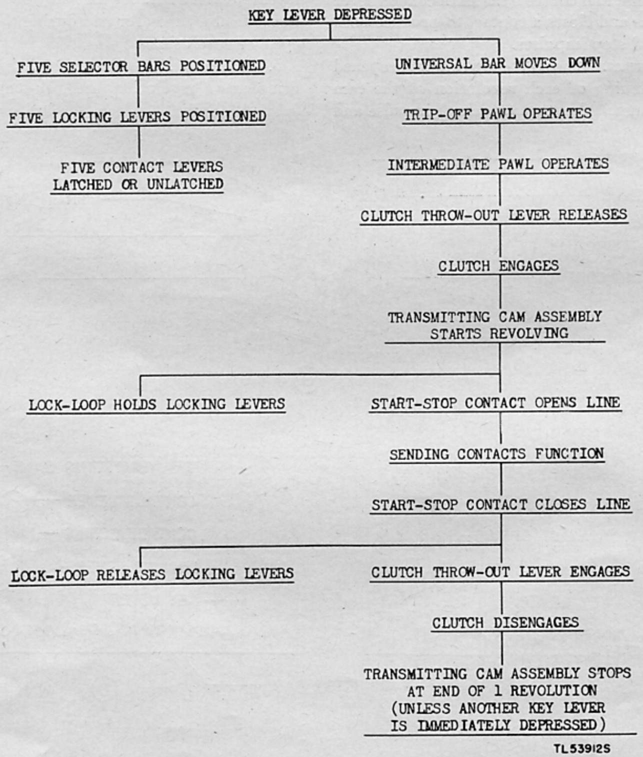

Figure 90. Sequence chart for keyboard functioning.

intermediate pawl (fig. 88). The intermediate pawl will, in turn, hold the clutch throw-out lever out of engagement with the throw-out cam on the clutch driven member. Thus, the transmitting-cam sleeve will be permitted to revolve continuously until the space bar is released. For instructions on the adjustment of the space-repeat device refer to paragraph 396 and 397.

c. Operation for Single Space. Normally, when the space bar is depressed, the space-repeat rod, attached to the keylever extension (fig. 88), moves the intermediate pawl forward, and holds the clutch throw-out lever out of engagement with the projection on the driven clutch. Thus, the transmitting-cam sleeve can revolve continuously until the space bar is released. When adjusted for a single space, the space bar functions in the same manner as the keylevers and must be released and again depressed for each space.

79. Typing Unit (General)

a. Description and Purpose. The typing unit includes, in a single assembly, all of the mechanism (except the motor) required to convert code impulses into typewritten messages. The detailed functioning of the various parts and subassemblies of the typing unit is arranged to group the individual functions which occur as a train of actions. Detailed data and associated illustrations are arranged in separate paragraphs below.

b. Operations. All mechanically operated parts of the typing unit receive their motive force from the main shaft assembly. This assembly is directly connected through the main shaft gear to the motor pinion. As long as the motor operates, power is transferred through the various cams, gears, and clutches to rotate the various parts of the typing unit at the speeds required to synchronize their mechanical actions with the code impulses that electrically energize the selector magnet. Charts and lists showing the sequence of operations for the different trains of actions appear near the related text matter. The selector magnet, through the associated selecting mechanism, determines the operation of the typing unit in printing a symbol or performing a nonprinting function of the equipment. The nonprinting functions are—

(1) Platen *line feeds.*
(2) Type-bar *carriage returns.*
(3) Type-bar *carriage spaces.*
(4) Platen shifts from letters to *figures.*
(5) Platen unshifts from figures to *letters.*
(6) Blank (on Teletypewriter TT–5/FG only); sends a dash in FIGS position on Teletypewriter TT–6/FG.
(7) Signal *bell* operates.
(8) Remote motor control *stop* opens (FIGS H on Teletypewriter TT–5/FG only).

80. Selector Unit

a. Description and Purpose. The selector unit is located on the left end of the typing unit and is shown in figures 91, 92, and 93. It consists of a selector magnet, a selector armature, five selector levers, five swords, five T levers, and a selector mounting plate with posts and springs. The range-finder assembly is associated with the selector unit. The selector-unit mechanism translates the marking and spacing impulses received from the line into a series of mechanical actions. These actions cause the vanes on the front of the typing unit to be positioned according to the character or function assigned to each combination of five selecting impulses. The selector mechanism is controlled by the armature of the selector magnet which receives the code impulses from the line through the polar line relay. (During discussion of the action of the selector magnet, the polar line relay with which these teletypewriters are equipped is not considered.) For description and action of the relay, see paragraph 116. Normally, the selector magnet armature is pulled up and the stop arm rests against the stop lever, which in turn is held by the trip latch. The cam sleeve does not revolve because the stop arm, which is part of the selector-cam sleeve, is engaged by the stop lever (fig. 92).

b. Operation. Upon receipt of a start impulse (spacing) by the selector magnet, the armature is released and is pulled away from the magnet pole pieces by the armature spring. This moves the trip latch out of engagement with the stop lever, releases the stop arm, and allows the cam sleeve to rotate with the shaft. In turn, each of the vanes is operated through T lever, a sword, and a selector lever (fig. 95). The train of action that results from the positioning of the vanes is discussed in paragraph 82.

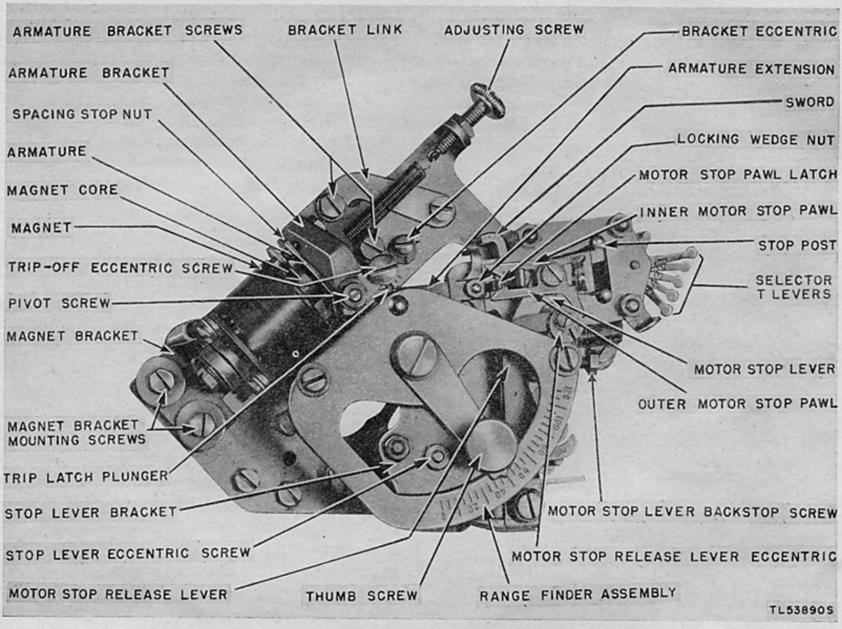

Figure 91. Selector unit.

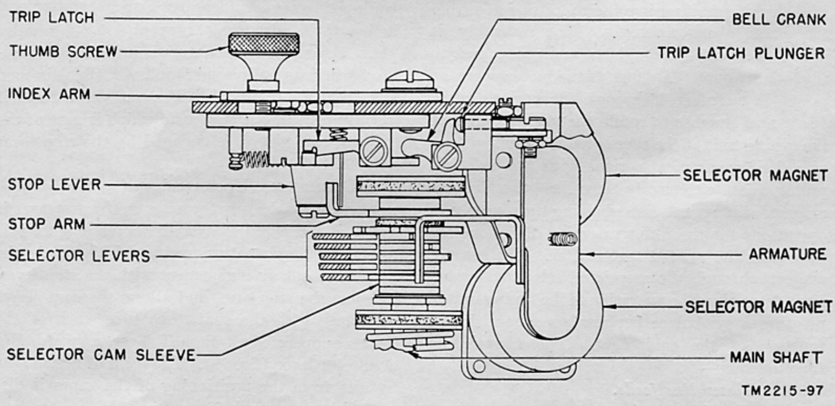

Figure 92. Cross section of selector unit.

81. Orientation of Selecting Mechanism (Range Finder)

a. DESCRIPTION AND PURPOSE. The range finder is directly associated with the selector magnet (fig. 93). A stop lever, trip latch, index arm, scale, and thumbscrew are the principal parts of the range finder, which is designed to adjust the relation between the start of the selector cam sleeve and the time the selector cams operate the selector levers. Adjusting the range finder is frequently referred to as orienting or taking the range of the teletypewriter.

b. OPERATION. The index arm is moved first toward one end and then toward the opposite end of the scale. The index arm is moved until the exact points at both ends on the scale, where the teletypewriter fails to print properly, are found. Midway between these extremes is the most favorable position to utilize the receiving margin of the selector mechanism. The index arm is held in adjustment by tightening the thumbscrew. For test and instructions for setting the range finder, refer to paragraph 22*e*.

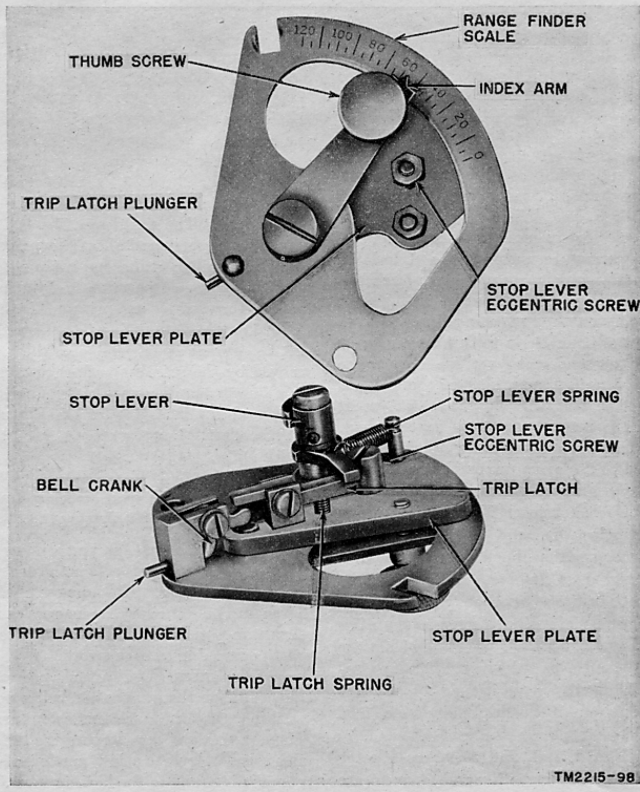

Figure 93. Range-finder mechanism.

UPPER CASE	WEATHER SYMBOLS	↑	⊕	○	↗	3	→	↘	↓	8	↙	←	↖	.	⦶	9	0	1	4	'	5	7	⌽	2	/	6	+	−						
	COMMUNICATIONS	−	?	:	$	3	!	&	£	8	'	(	)	.	,	9	0	1	4	'	5	7	;	2	/	6	"							
LOWER CASE	COMMUNICATIONS AND WEATHER	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	BLANK	C.R.	L.F.	SPACE	LTR. SHIFT	FIG. SHIFT	TIME IN MILLI-SECONDS
● = MARK □ = SPACE	START																																	22
	1	●	●		●	●	●				●	●						●		●		●		●	●	●	●					●	●	22
	2	●		●				●		●	●	●	●				●	●	●			●	●	●						●		●	●	22
	3			●			●		●	●		●		●	●		●	●		●		●	●		●	●					●	●		22
	4		●	●	●		●	●			●	●		●	●	●			●				●		●				●			●	●	22
	5		●					●	●				●	●		●	●	●			●		●	●	●	●	●					●	●	22
	STOP	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	31
TOTAL ELAPSED TIME PER CHARACTER INCLUDING START AND STOP ELEMENTS																																		163

TM2215-99

Figure 94. Five-unit teletypewriter code.

82. Example of Selector Unit Operation

a. Assume that the letter E is received; the code sequence for the E combination is shown in figure 94—it consists of: space (start), mark, space, space, space, space, and mark (stop). Note (fig. 94) that the first six impulses are 22 milliseconds long, whereas the last, or stop impulse, is of 31 milliseconds duration. When the start impulse reaches the selector magnet the armature is released. The armature pushes the trip-latch plunger (fig. 92), which causes the trip-latch bell crank to move the trip latch out of engagement with the stop lever, thus releasing the stop arm.

b. The selector cams begin to turn and selector cam No. 1 engages selector lever No. 1 when the first selecting impulse (marking) of the letter E is received. The marking impulse is a current impulse and the magnet armature is, therefore, attracted to the selector magnet. This brings the upper end of the armature extension into the path of the upper arm of the sword. When cam No. 1 engages selector lever No. 1, this lever is rotated counterclockwise, and carries with it the sword which strikes the upper extension, and is turned clockwise about its pivot (A, fig. 95). The sword is then positioned so that when cam No. 1 clears the selector lever, the selector-lever spring moves the sword against the T lever and brings the front edge of vane No. 1 down so that its associated code bar will be positioned to the left through the medium of the No. 1 bell crank (figs. 95 and 96).

c. As cam Nos. 2, 3, 4, and 5 engage selector lever Nos. 2, 3, 4, and 5, vane Nos. 2, 3, 4, and 5 are moved so that their front edges are tilted up. With the front edges of these vanes tilted up, the corresponding code bars are moved to the right by the connecting bell cranks. With the front edges of the vanes tilted down, the bell cranks move the corresponding code bars to the left.

d. With code bar No. 1 positioned to the left and code bar Nos. 2, 3, 4, and 5 positioned to the right, one notch in each code bar is opposite the E pull bar. The sixth cam (fig. 99) releases the main-shaft clutch and allows the printing bail and function bail to make one complete cycle. The printing-bail cam permits the printing bail to be pulled forward by its spring. The E pull bar is pulled down by its spring into the path of notches set up by the code bars, and the pull-bar bail, moved by the printing bail, then carries the pull bar forward and causes the type bar to strike the platen and print the letter E. Figure 98 is a sequence chart showing operation of the selecting mechanism.

83. Locking Cam and Locking Lever

a. Description and Purpose. The locking cam (A, fig. 95) has six high and six low surfaces on its periphery against which the locking lever is held by its spring. The purpose of this cam and lever is to hold the selector-magnet extension arms firmly in position just long enough to insure correct positioning of each sword.

b. Operation. During that part of a code sequence when the swords are being positioned by striking the armature extension arms (at the moment that any cam is operating the corresponding selector lever), a low portion of the locking cam is presented to the locking lever. The armature extension is then held firmly in position by

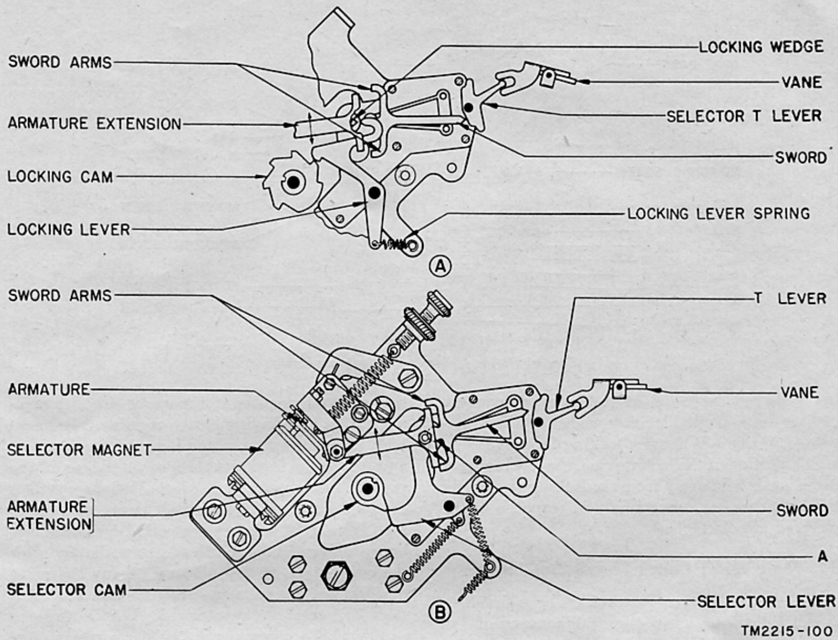

Figure 95. Locking lever operation and side view of selector unit.

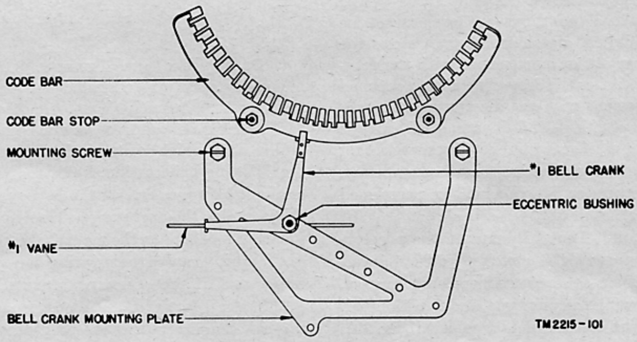

Figure 96. Vane, bell, crank, and code bar linkage

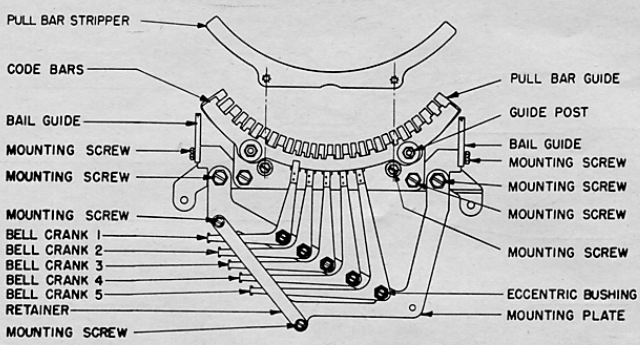

Figure 97. Code-bar bell crank assembly.

the V-shaped extension of the locking lever engaging the V-shaped locking wedge on the armature extension. When the locking lever is riding a high portion of the locking cam, the locking lever extension is held away from the locking wedge and the armature can move freely in response to the received impulse.

84. Main Shaft Clutch Throw-Out Lever

a. Description and Purpose. The main shaft clutch throw-out lever (fig. 99) consists of the clutch-stop arm, the throw-out lever spring, and the throw-out arm. The extension of the clutch-stop arm rides on the driven clutch member of the main shaft and the throw-out is operated by the sixth cam. The clutch throw-out lever causes the cam on the driven clutch member to move the driven member out of engagement with the driving member. After the driven member is cammed out of engagement with the driving member, rotation of the printing- and function-bail cams is blocked until all five impulses of the selecting sequence have been received at the selector magnet. Thus, no printing or function will be performed before all the impulses are received.

b. Operation. The sixth cam on the selector-cam sleeve operates the clutch throw-out lever, allowing the main-shaft clutch members to engage, and thus allowing the printing- and function-bail cams to perform one complete revolution (fig. 99). At the end of each revolution of these cams the clutch-stop arm engages the cam surface on the driven clutch member and moves it out of engagement with the driving clutch member. Immediately after the five selecting impulses are received, and just as the fifth selector lever is sliding off the peak of its cam, the peak of the sixth cam strikes the clutch throw-out arm and moves the clutch-stop arm out of engagement with the cam surface on the driven clutch member. Immediately after the completion of the selection of any character or function, the printing- and function-bail cams (fig. 99) rotate 1 revolution. This causes the printing of a character or the performance of a function. The next character or function may be selected while the printing of the previous selection is taking place.

85. Printing

a. Description and Purpose. On the bail-mounting shaft are mounted the printing bail, printing-bail operating arm, function bail, and two spacing-escapement pawls. The printing-bail spring, which is attached to the right end of the printing-bail casting, holds the printing bail against the upper end of the bail-operating arm. It also holds the operating-arm roller against the printing-bail cam on the main shaft. The tension of the spring causes the printing bail to follow the upper end of the operating arm and moves the pull-bar bail forward. The position of the printing-bail cam determines the position of the printing bail (fig. 100), except as noted in paragraph 84. The purpose of this mechanism is to control

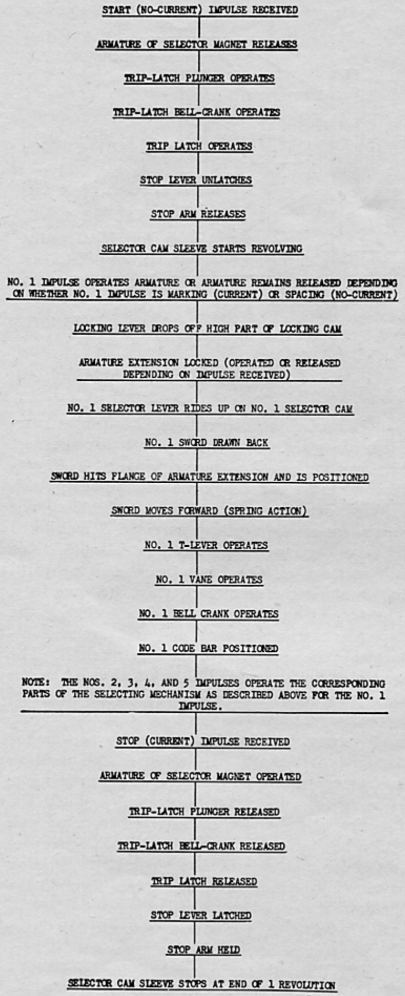

Figure 98. Sequence chart for operation of selecting mechanism.

the completion of the operating cycle which follows immediately after the selecting cycle.

b. Operation. The actual printing of characters is not caused by the printing bail but by the pull-bar bail, which is controlled by the printing bail through the pull-bar bail plunger roller (fig. 102). The roller (when the type-bar carriage is in place) is set between the printing-bail blades; this allows the carriage to move from left to right, and the pull bar to be moved backward and forward by the printing bail, regardless of the position of the type-bar carriage. At the end of each revolution of the printing-bail cam, the printing-bail operating-arm roller comes to rest on the high surface of its cam. The printing bail is then in its extreme rear position, being carried there against the tension of the printing-bail spring.

86. Type-Bar Carriage Printing Mechanism

a. Description and Purpose. The printing mechanism on the type-bar carriage consists of a pull-bar bail, pull bars, type bars, and mounting parts. The printing is done mechanically by the action of the pull-bar bail in throwing the type bars against the platen. Between the printing-bail blades is a plunger roller (fig. 102), which extends downward from the pull-bar bail plunger. Thus, the movement of the printing bail applies a reciprocating motion to the pull-bar bail to actuate the pull bars.

b. Operation. Selection of a type bar is determined by the setting of the five code bars. These are moved into position by the bell cranks (figs. 96, 97, and 102) which are controlled by the vanes. The code bars are arranged so that the notches in their upper sides will be alined so as to permit the selected pull bar to move down into the path of the pull-bar bail. As the pull-bar bail moves forward it will allow all pull bars to rest on the code bars under tension of the pull-bar springs. The selected pull bar will drop into the notch set up for it in the code bars, which will position it lower (with respect to the bail) then the other pull bars. As the pull-bar bail continues to move in its forward stroke, it will engage a notch in the selected pull bar, but will clear all the other pull bars. The forward motion of the selected pull bar will cause the associated type bar to strike the platen. Before the pull-bar bail

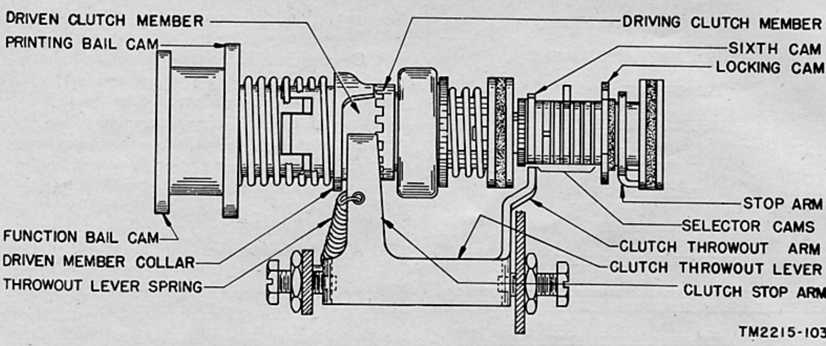

Figure 99. Section of main shaft.

reaches the limit of its forward motion a stripper plate (fig. 101), which is located below the pull bars, cams the selected pull bar off the bail and the type bar is carried against the platen by momentum. As the roller on the printing-bail arm rides to the peak of its cam to complete the printing cycle, the printing and pull-bar bails move to their rear positions. The pull bars will then be raised clear of the code bars so that they are free to respond to the next selection.

87. Locking-Function Lever

a. Description and Purpose. The locking-function lever is the first on the right of the function levers mounted behind the vanes. The locking-function lever (fig. 103) locks the vanes in the selected position until a character has been printed or a function performed.

b. Operation. When the printing bail moves forward, the function-lever bail roller moves downward off the high part of the function-lever rear arm. This allows the locking-function lever spring to pull the lever against the rear edges of the vanes. The locking-function lever engages each vane, whether in the marking or spacing position, and locks the vanes in the selected position until the printing-bail cam has completely revolved. The operation of the other function levers is covered under the related function. Figure 100 is a sequence chart that illustrates the operation of the printing mechanism.

88. Spacing

a. Description and Purpose. For proper spacing between characters, the type-bar carriage must be moved with each character printed. The type-bar carriage is moved by the spacing gear which meshes with the spacing rack (fig. 108). The movement of the type-bar carriage is facilitated by three carriage support rollers. Two of these rollers move on the front track and the third moves along the rear track (figs. 102 and 104). The spacing rack is mounted on the rear of the type-bar carriage casting and the pinion is attached to the upper end of the spacing shaft. The spacing shaft, extending downward, passes through the spacing-shaft gear. Just above its lower bearing, the spacing shaft mounts the carriage return clutch, the lower member of which is fastened to the shaft. The return-clutch members are engaged at all times except when the carriage is being returned from the end of a line. The function of the clutch is described in paragraph 69. The spacing-shaft gear meshes with the spacing pinion on the main shaft (par. 69). Spacing is controlled from the printing bail through the medium of escapement pawls.

b. Operation. The spacing action results from the sequence of actions that follow:

(1) With the printing bail in its rear position, the rear escapement pawl is engaged by one of the teeth on the spacing escapement ratchet (fig. 107). This holds the ratchet and spacing gears stationary.

NO. 6 CAM OF SELECTOR CAM SLEEVE OPERATES CLUTCH THROW-OUT LEVER

MAIN-SHAFT CLUTCH MEMBERS ENGAGE

BAIL-CAM UNIT STARTS REVOLVING

PRINTING-BAIL OPERATING ARM OPERATES

PRINTING BAIL MOVES FORWARD

PULL-BAR BAIL PLUNGER ROLLER RIDES FORWARD BETWEEN PRINTING-BAIL BLADES

PULL-BAR BAIL MOVES FORWARD, ALLOWING
ALL PULL BARS TO POSITION AGAINST CODE BARS

SELECTED PULL BAR DROPS INTO CODE-BAR SLOT AND INTO PATH OF PULL-BAR BAIL

CONTINUED FORWARD MOVEMENT OF PULL-BAR BAIL ENGAGES SELECTED PULL BAR

SELECTED PULL BAR MOVES FORWARD

TYPE BAR (GEARED TO PULL BAR) FORCED UP

STRIPPER PLATE DISENGAGES PULL BAR FROM PULL-BAR BAIL
WHEN TYPE BAR IS APPROXIMATELY 1 INCH FROM PLATEN

TYPE BAR HITS PLATEN UNDER ITS OWN MOMENTUM
AND RETURNS TO NORMAL POSITION (SPRING RETURN)

PRINTING BAIL MOVES BACKWARD

PULL-BAR BAIL MOVES BACKWARD, POSITIONING
ALL PULL BARS AWAY FROM CODE BARS

NOTE: LOCKING FUNCTION LEVER (EXTREME RIGHT FUNCTION LEVER) LOCKS
ALL VANES IN SELECTED POSITION DURING PRINTING.

CLUTCH STOP-ARM ENGAGES WITH CAM SURFACE ON DRIVEN CLUTCH MEMBER

MAIN-SHAFT CLUTCH MEMBERS MOVED OUT OF MESH

TL53914S

Figure 100. Sequence chart for printing mechanism.

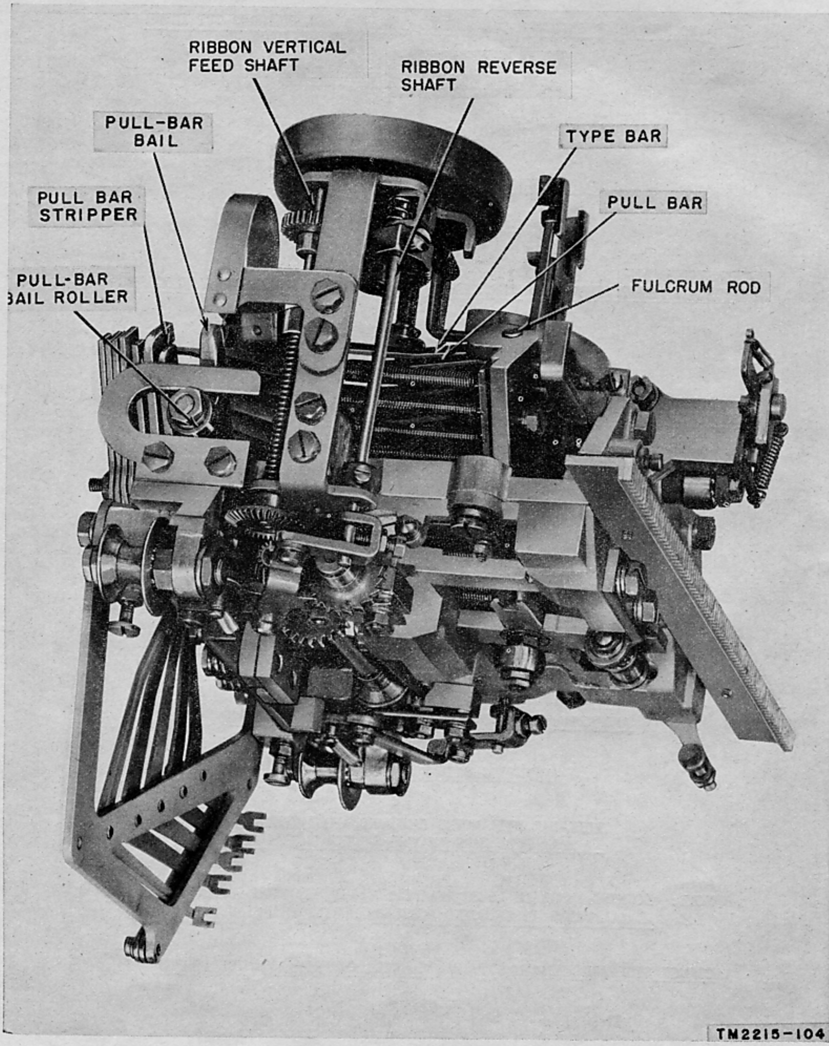

Figure 101. Type-bar carriage, lower right-hand view.

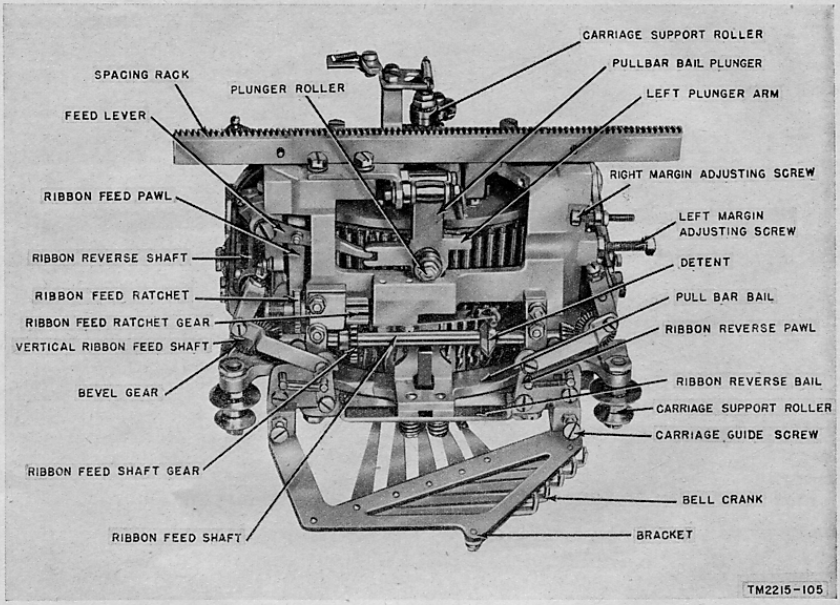

Figure 102. Type-bar carriage, bottom view.

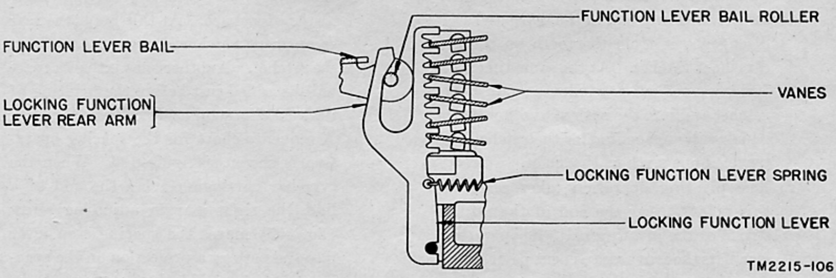

Figure 103. Locking-function lever.

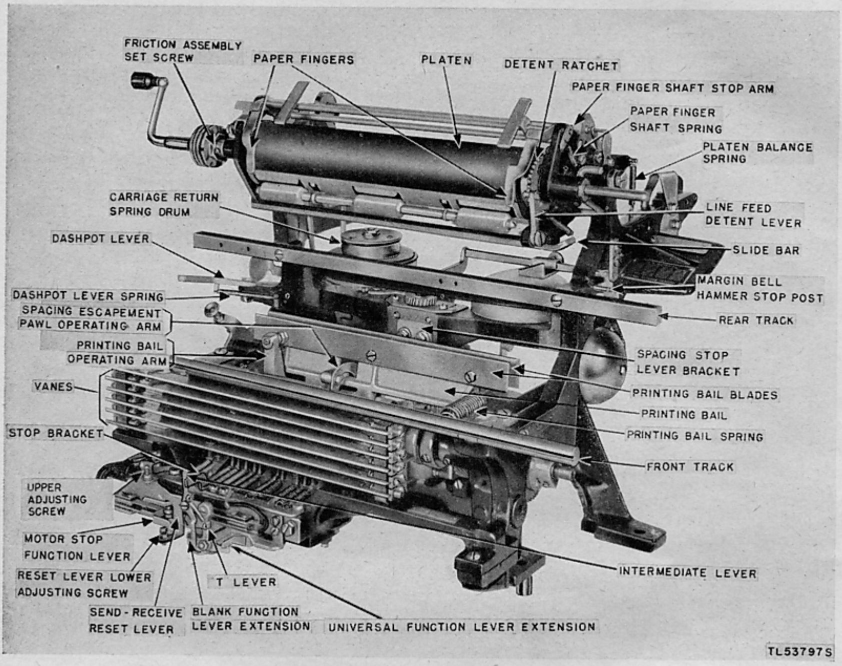

Figure 104. Typing unit with type-bar carriage removed, front view.

As the printing bail begins to move forward, the escapement pawl operating arm strikes the lower end of the rear pawl and disengages it from the tooth on the escapement ratchet. At the same time, the front escapement pawl moves against the ratchet and into the path of another tooth which will engage it after the ratchet has traveled one-sixth of the space.

(2) The printing operation takes place at this point. Near the end of the return stroke of the printing bail, the operating arm lifts the front escapement pawl out of engagement with the escapement ratchet and, at the same time, the rear pawl moves against the ratchet. This action permits the spacing mechanism to revolve sufficiently to space the carriage five-sixths of a space. At this point the rear escapement pawl will engage a tooth on the ratchet. Another one-sixth of a space will be added just before the printing of the next character as described above.

(3) A sequence chart for the spacing operation is shown in figure 106. When the type-bar carriage reaches the end of a line, the right margin adjusting screw (fig. 107) moves the spacing stop lever into the path of a projection on the spacing stop sleeve, blocks rotation of the spacing mechanism, and prevents further spacing of the carriage.

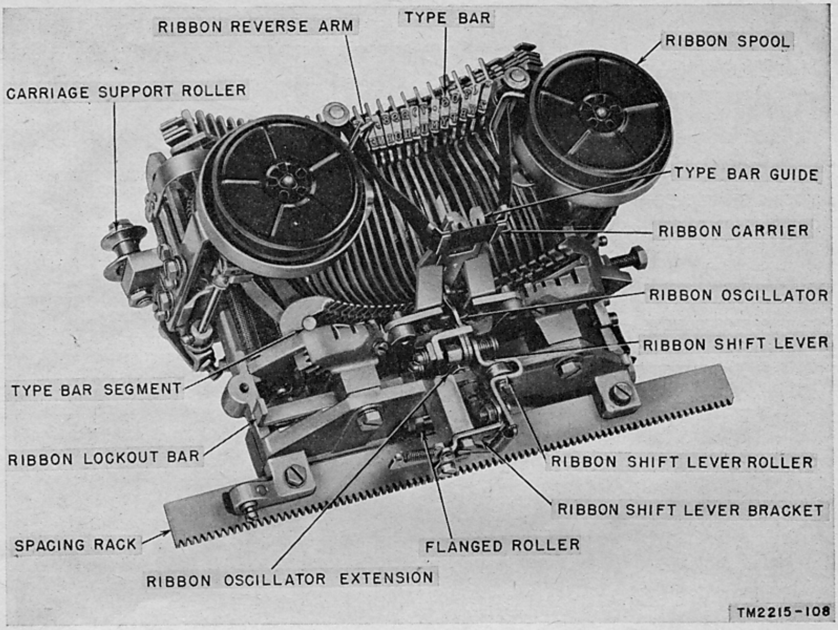

Figure 105. Type-bar carriage, rear view.

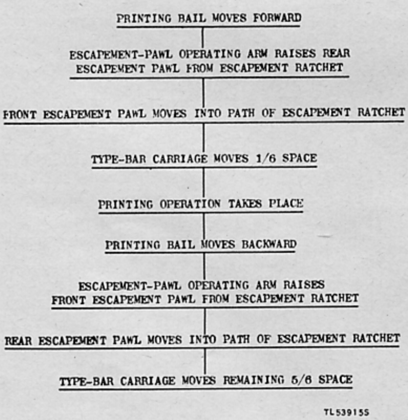

Figure 106. Sequence chart for spacing operation.

89. Margin Signal Bell

a. Description and Purpose. A margin bell is mounted in a vertical position on the right side of the typing unit (figs. 108 and 109). This bell warns the operator that the type-bar carriage is approaching the end of a line. The bell hammer is attached to the margin-bell camshaft. An adjustable cam is fastened on the camshaft and forces the shaft to pivot when depressed.

b. Operation. The margin-bell pawl on the type-bar carriage will depress the margin-bell cam which pivots the shaft. This moves the bell hammer away from the bell against the tension of its spring. When the bell pawl has been spaced beyond the cam, the bell hammer will be released and its spring will cause the hammer to strike the bell.

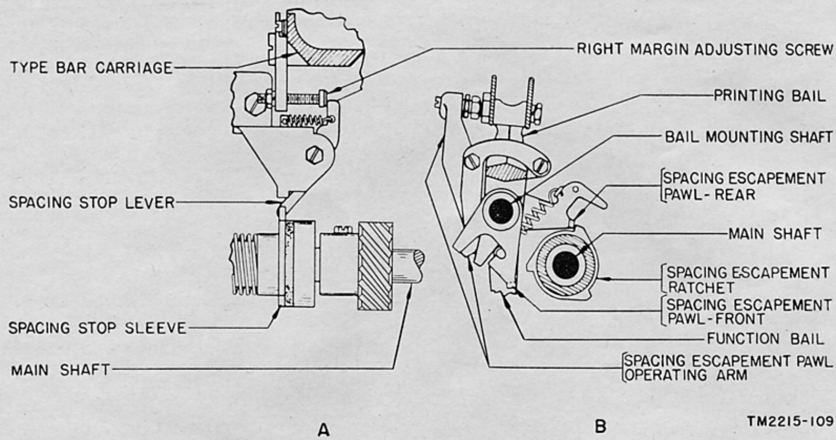

Figure 107. Spacing stop mechanism.

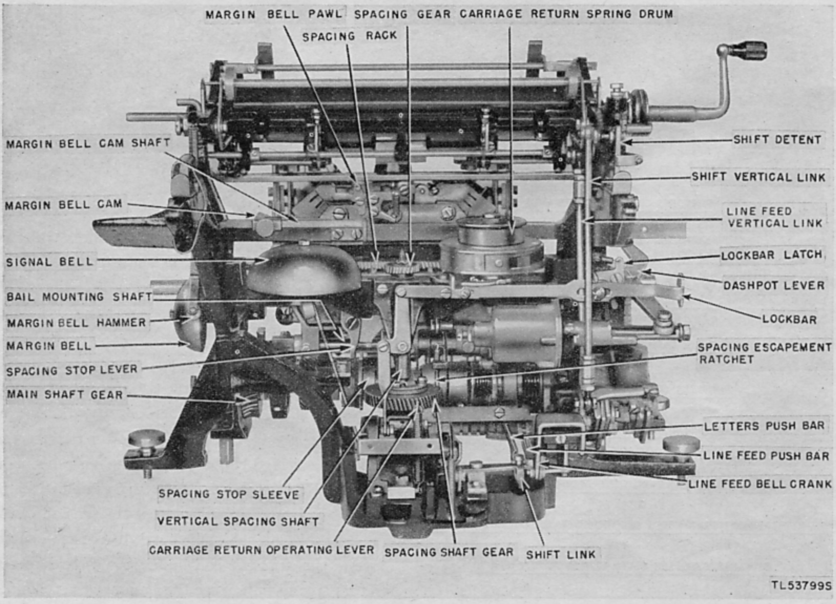

Figure 108. Typing unit, rear view.

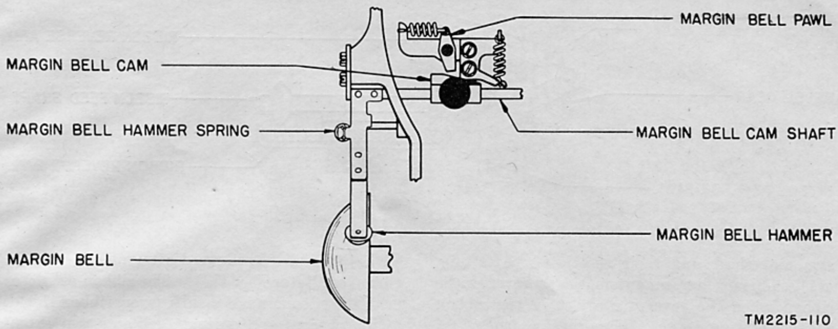

Figure 109. Margin-bell mechanism.

90. Ribbon-Feed Mechanism

a. Description and Purpose. The type-bar carriage ribbon mechanism consists of two ribbon-spool cups and associated parts (figs. 110 through 113). The entire assembly is similar to the ribbon mechanism of the conventional typewriter. Each ribbon-spool cup is mounted on a bracket, having a vertical ribbon-feed shaft and a ribbon-reverse shaft. The vertical ribbon-feed shaft is engaged by the horizontal ribbon-feed shaft. The end of the ribbon-feed lever engages the notched extension of the pull-bar bail plunger (fig. 110). The ribbon-feed pawl, which moves the ribbon-feed ratchet, is attached to the ribbon-feed lever. This prevents the type bar from hitting the ribbon in the same place twice in succession. The ribbon-reverse mechanism is described in paragraph 91.

b. Operation. With each operation of the pull-bar bail plunger, the ribbon-feed ratchet and the ribbon-feed ratchet gear are advanced one tooth. The shaft mounting the ribbon-feed ratchet gear imparts motion to the ribbon-feed shaft. The left (or right) ribbon-feed shaft gear meshes with the left (or right) vertical ribbon-feed shaft bevel gear. The vertical ribbon-feed shaft causes the ribbon-spool shaft to rotate. The ribbon spool rotates with the ribbon-spool shaft.

91. Ribbon-Reverse Mechanism

a. Description and Purpose. The ribbon-reverse mechanism consists of the ribbon-reverse

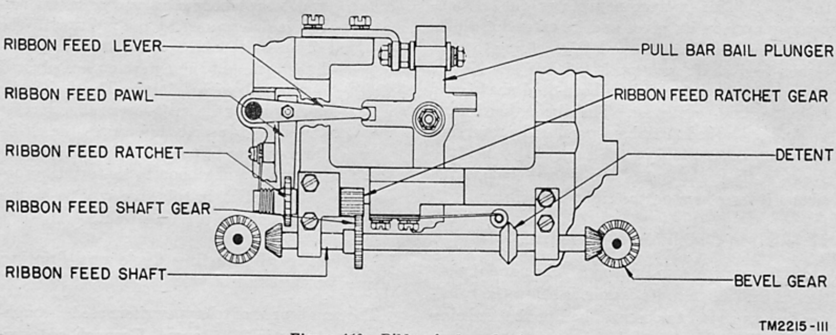

Figure 110. Ribbon-feed mechanism.

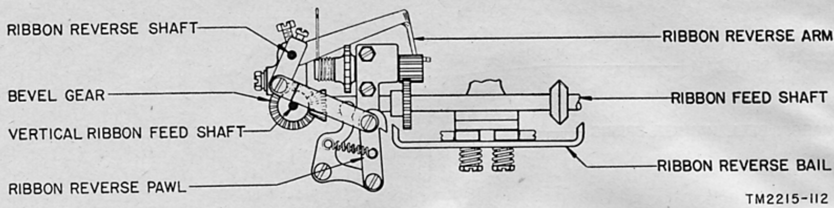

Figure 111. Ribbon-reverse mechanism.

arm and shaft and their associated parts (fig. 111). This mechanism automatically reverses the ribbon when the reversing eyelet in the ribbon engages and moves the ribbon-reverse arm.

b. OPERATION. Assuming that the ribbon is being wound upon the right ribbon spool (and is almost entirely unwound from the left ribbon spool), the eyelet in the ribbon near the end engaged by the left spool will touch the left ribbon-reverse arm, and further winding of the ribbon will move that arm. This arm is fastened to the left ribbon-reverse shaft and moves the left ribbon-reverse pawl into the path of the ribbon-reverse bail (fig. 111). This is accomplished by the movement of the left ribbon-reverse arm to the rear by the ribbon eyelet. The left ribbon-reverse shaft, on which the ribbon-reverse arm is mounted, rotates the ribbon-reverse shift link which, in turn, moves the ribbon-reverse pawl link. The ribbon-reverse pawl link moves the ribbon-reverse pawl into the path of the ribbon-reverse bail. On the rearward movement of the bail, the bail engages the ribbon-reverse pawl and carries the pawl to the rear. This movement rotates the ribbon-reverse lever on its pivot and its extension shifts the ribbon-feed shaft to the left, engaging the left ribbon-feed shaft gear with the left bevel gear. This disengages the right ribbon-feed shaft gear from the right bevel gear. The ribbon then begins to wind upon the left ribbon spool. The reversing operation takes place in the same way when the eyelet in the right end of the ribbon engages the ribbon-reverse arm on the right ribbon spool.

92. Ribbon-Oscillator Mechanism

a. DESCRIPTION AND PURPOSE. The normal position of the ribbon in its carrier is below the printing line, so as not to obscure the line that is being typed. The ribbon is raised before the type bar strikes it, and it is lowered after printing by the ribbon oscillator (fig. 113). The ribbon-oscillator mechanism consists of a shift lever, ribbon shield, oscillator arm and spring, oscillator-arm extension, shift-lever roller and spring, all mounted on the ribbon-oscillator bracket.

b. OPERATION.

(1) *Platen in LTRS position.* The ribbon-oscillator-arm extension, which is fastened to its arm by an adjusting screw, is moved to the rear by an extension on the pull-bar bail plunger, and it rides in a slot in the carriage casting. When the pull-bar bail moves forward, the ribbon-oscillator-arm spring raises the arm and causes the ribbon shield (attached to the front of the arm) to raise the ribbon into the path of the type pallet. When the pull-bar bail moves to the rear, pressure is exerted upon the ribbon-oscillator-arm extension which causes the mechanism to drop the ribbon below the printing line.

(2) *Platen in FIGS position.* The height to which the ribbon oscillator raises the ribbon is determined by the position of the ribbon-shift lever roller. Both the oscillator arm and the extension are pivoted on the ribbon-shift lever. The shift-lever spring holds the shift-lever roller against the slide bar and this causes the shift-lever spring to pull the ribbon-oscillator assembly and ribbon to the printing position, which in this case will be higher than that for printing LTRS.

93. Overlap of Selecting Cycle and Printing or Function Cycle

The usual speed of teletypewriters used throughout the Army is 368.1 opm. Through an over-

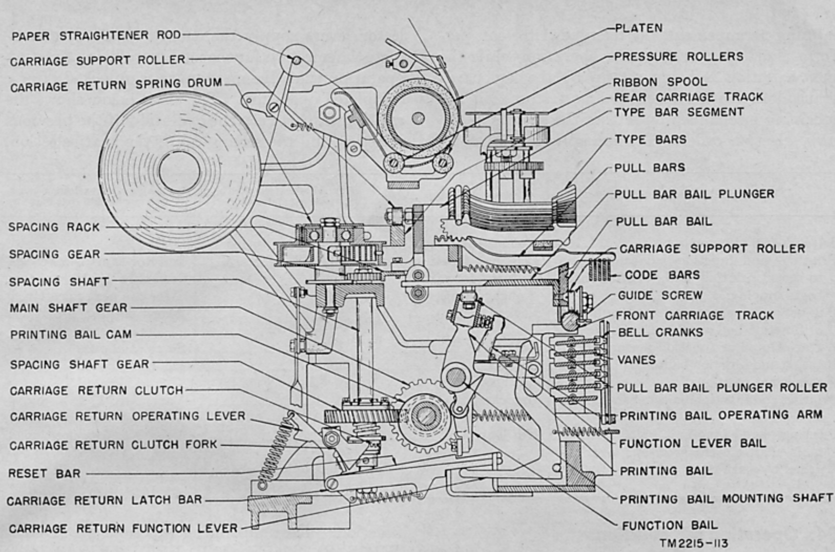

Figure 112. Typing unit, end view.

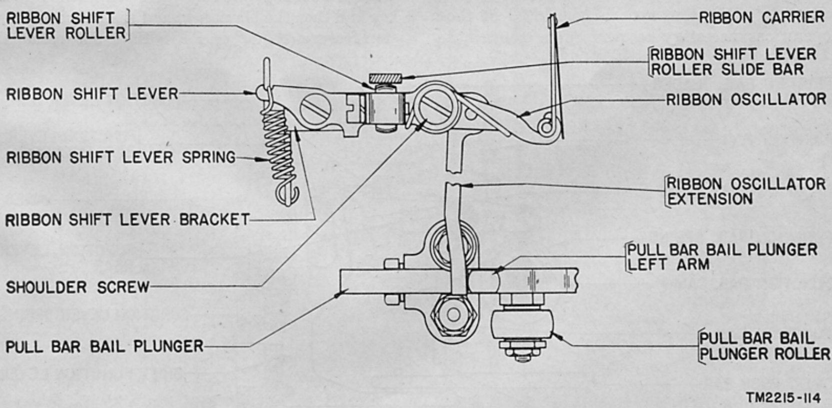

Figure 113. Ribbon-oscillator mechanism.

lapping arrangement, the teletypewriter can perform a printing or function operation while the next selection is being set up by the keyboard-transmitter, and transmitted and stored in the receiving mechanism by setting the swords in the new selection order. Tension springs on the selector levers supply the energy required to complete the selection for the next printing or function operation when the mechanism is unlocked after a completed operation. The chart below shows the relationship between the operation of the previous selection and the setting up of the next selection.

Operation of previous selection	Locking of previous selection	Impulse of next selection being received and/or stored	Positioning of next selection vanes, bell cranks, and code bars
Selector cam sleeve stopped	Not locked	STOP.	
Printing- and function-bail cams begin to turn; printing and function bails begin moving.	Locking function lever starts forward to engage vane.	START	Selector-cam sleeve assembly begins to turn for the next selection.
Pull-bar bail engages selected pull bar, or function bail engages a push bar.	Locked	1	Sword positioned and new selection stored.
Letter printed or function performed	Locked	2	Same as above.
Printing and function bails start to return to normal positions.	Locked	3	Same as above.
Printing and function bails nearly normal	Unlocked	4	Vane Nos. 1, 2, 3, and 4, are set simultaneously.
Printing and function bails normal; main shaft clutch throw-out lever engaged by sixth cam.	Not locked	5	Vane No. 5 is positioned.

94. Operation of Functions

a. Description and Purpose. The typing unit can perform two types of operations: one type comprises those operations required to print a character; the other type is comprised of those operations necessary to perform a nonprinting function. The nonprinting functions are: BELL (FIGS S), blank, CAR RET, FIGS, LTRS, LINE FEED, STOP (FIGS H), and space. On weather communication keyboards and typing units, a dash is printed by operation of the FIGS key and then the blank key, and the remote motor stop feature (STOP on FIGS H) is not included.

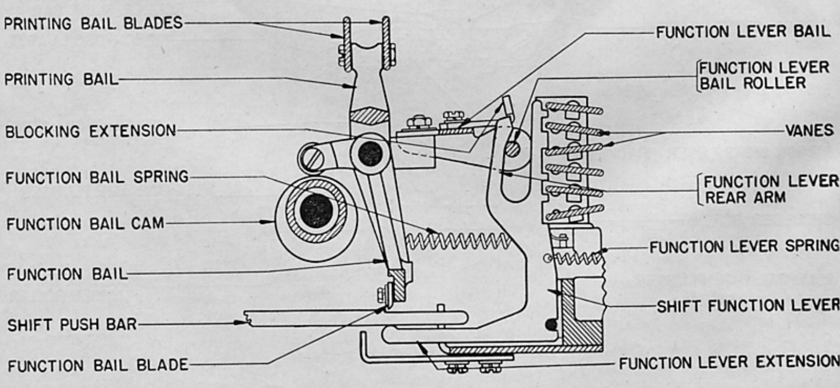

Figure 114. Function-lever mechanism.

The functions are completed through the operation of separate function levers which are located behind the vanes in the front of the typing unit.

b. Operation. When the printing bail is in its normal or rearmost position, the function-lever bail attached to it holds the function levers away from the vanes. As the printing bail moves forward, the function-lever bail roller moves off the high portion of the rear arms of the function levers, thus permitting the function-lever springs to pull their levers against the vanes. The forward arms of the function levers are notched so that when a function combination is set up on the vanes, the selected function lever moves forward farther than the other function levers. The function-lever extension then moves the selected push bar upward and into the path of the function bail or releases a latch bar to perform the correct function when selected.

95. Function Bail

a. Description and Purpose. The function bail is mounted on the bail mounting shaft. It is used to operate some of the functions and is moved by the function-bail cam. The function bail has a blade attached to its lower extremity which engages the function push bars and reset bars.

b. Operation. The function-bail spring holds the function-bail cam roller against its cam at all times. After the printing bail and function-lever bail move far enough to release the function levers (fig. 115), the function-bail roller starts to ride the cam. The function-bail blade moves toward the rear, engaging and operating any reset bar in the path or any function push bar that may have been moved into its path by a function-lever extension, and the function bail returns to its forward position. The bail cam unit on the main shaft has not yet completed its revolution at this point, and the function-bail roller comes to rest. The roller rests beyond the low part at a point about one-half the distance to the peak of the cam.

96. Position of Function Levers

The position of function levers in the function-lever comb are listed in the chart below, showing the designations which can be seen from the top and bottom of the typing unit (fig. 115).

No. on bottom	Function lever	Designation on top
1	Locking	None
2	Carriage return	CR
3	Figures shift	FIG
4	Bell	BELL
5	Universal	None
6	Vacant	TAB
7	Printing and space suppressor	None
8	Sixth vane detent	None
9	Unshift on space	SP
10	Blank	BL
11	Letters shift	LTRS
12	Line feed	LF
None	Motor stop	STOP

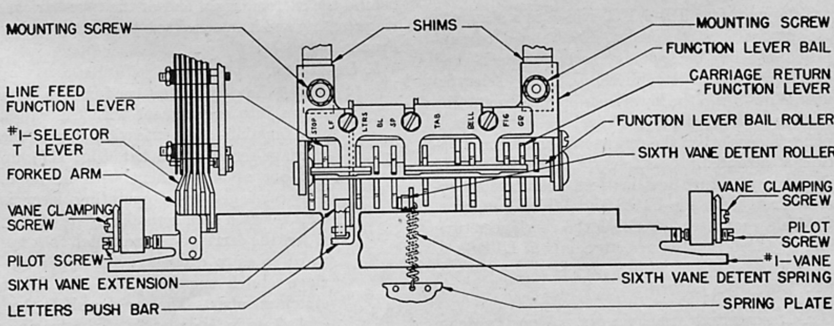

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Figure 115. Function levers.

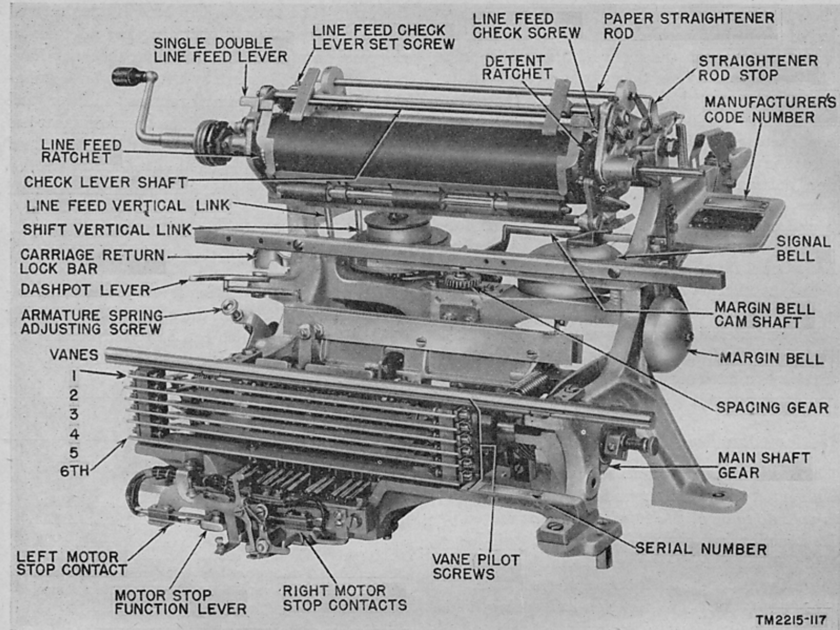

Figure 116. Typing unit with carriage removed.

97. Function Suppression

Teletypewriter TT–5/FG, which is a standard communications equipment, is arranged to suppress printing or spacing on both upper- and lower-case blank combinations. On Teletypewriter TT–6/FG the lower-case blank combination also suppresses printing and spacing. However, it prints a dash when the upper-case blank combination is operated. On Teletypewriter TT–5/FG the carriage-return and line-feed combinations operate from both the FIGS and LTRS positions. On Teletypewriter TT–6/FG the carriage-return and line-feed functions operate only at LTRS.

98. Carriage Return

a. Description and Purpose. A spring drum (fig. 108) is the source of power that returns the type-bar carriage to the left-hand margin by the use of a draw strap. The draw strap is connected behind the extreme right end of the type-bar carriage casting and is fastened to a post on the spring drum.

b. Operation.

(1) When the carriage-return function lever moves into engagement with the vanes, the function-lever extension moves the carriage-return latch bar (fig. 117) up and out of engagement with its latch. The carriage-return operating lever is thus released and, actuated by its spring, moves the carriage-return clutch fork upward so as to disengage the upper carriage clutch member from the lower clutch member. The spacing shaft then can rotate independently of the spacing-shaft gear. This permits the type-bar carriage to be returned to its extreme left

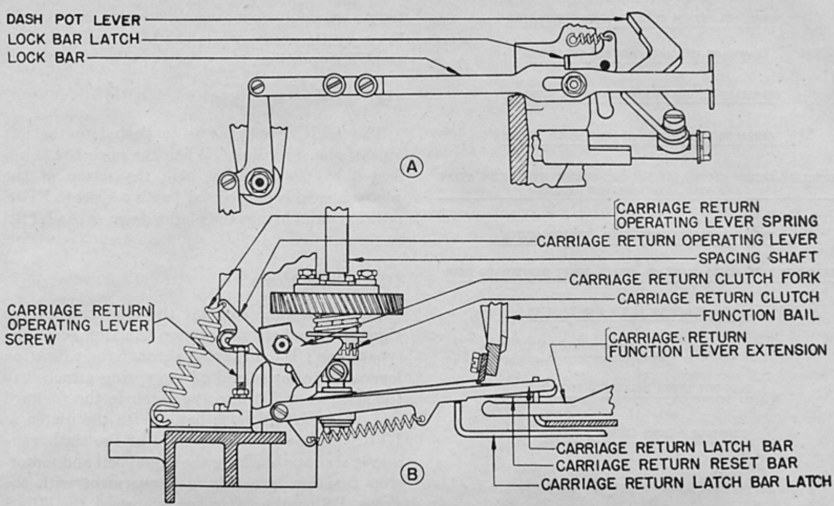

Figure 117. Carriage-return mechanism.

position by the carriage-return spring and draw strap.

(2) The notch on the reset bar will then be engaged by the function-bail blade and the reset bar will be moved toward the rear. Because the reset bar and the carriage-return latch bar are both pivoted on the same pivot screw, the latch bar will be reset and engaged by its latch (B, fig. 117). In the meantime, the function-lever bail will return to its upper position, and the carriage-return and the function-lever extension will move down below the (unlatch point) latching surface of the latch bar.

(3) As the carriage-return clutch fork disengages the carriage-return clutch, it also actuates a lock bar (fig. 117) which is linked to it. The sliding motion of the lock bar permits a shoulder in its upper edge to pass under and engage a lock bar latch mounted above the lock bar. Engagement of the lock bar latch holds the carriage-return clutch disengaged until the carriage has fully returned to the extreme left position.

(4) Just before the carriage reaches its position at the extreme left margin the left margin-adjusting screw, attached to the carriage, strikes the front end of a centrally pivoted dash-pot plunger lever (fig. 116 and A, fig. 117). The dash-pot plunger is driven into the dash-pot air chamber and thereby absorbs the shock of the carriage.

(5) With the carriage-return latch bar engaged with the latch bar latch and the driven and driving members of the spacing clutch engaged, the carriage-return mechanism is in position to receive the next selection. A sequence chart for the carriage-return function is shown in figure 118.

c. Manual Carriage Return. To return the carriage manually, operate the lock bar (A, fig. 117) through the aperture in the typing unit cover. When the lock bar is pressed, it disengages the

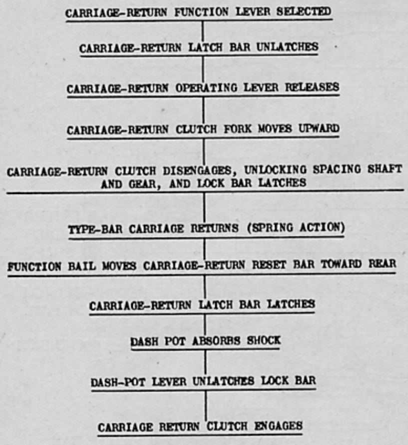

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Figure 118. Sequence chart for carriage return.

spacing-shaft clutch and causes the type-bar carriage to return to the left-hand margin.

99. Figures (Shift)

a. Description and Purpose. The figures shift function lever (third from the right) starts the train of actions which moves the platen from the letters (LTRS) to the figures (FIGS or upper case) printing position. This function lever and its operation are described in *b* below. The function bail provides the motive force required to move the platen through the push bar, shift link, and shift lever.

Note. The shift detent holds the platen assembly firmly in either the FIGS or LTRS position.

b. Operation. Selection of the FIGS function lever raises the FIGS shift push bar so as to bring its notch into the path of the function-bail blade (fig. 114). This push bar, moved by the function bail, rotates the right end of a shift link (to which it is connected) toward the rear (fig. 119). As the shift link pivots, a shift lever, connected to its left end, rotates counterclockwise (viewed from left) and exerts a downward pull upon a vertical shift link that extends upward between the shift lever and the platen bracket. The rear platen assembly is moved downward and is held there by its detent while the platen roll rises to the FIGS position.

100. Letters (Unshift)

The LTRS push bar is connected to the left side of the shift link. When the push bar is operated by the function bail, the action at the platen assembly is reversed (with respect to FIGS position) and brings the platen down to the LTRS position.

101. Sixth Vane

The sixth vane controls the operation of the signal bell and the motor-stop function (on Teletypewriter TT–5/FG only) through their function levers. The lower end of the spring attached to the sixth vane fits into the notch in the forward end of the LTRS push bar. With the platen at LTRS position, the rear edge of the sixth vane moves up, thus blocking the signal bell and motor-stop function levers from engagement with the vanes. When the FIGS key is pressed, the LTRS push bar moves forward causing the rear edge of the sixth vane to go to the lower position, thus allowing the signal bell or motor-stop function lever to be selected and operated.

102. Spacing Function

Spacing other than that accompanied by printing (such as spacing between words) is performed in the same manner as that described in paragraph 88 with a single exception. That is, that there is no pull bar to be selected.

103. Unshift-on-Space

a. Description and Purpose. Teletypewriters TT–5/FG and TT–6/FG can be arranged to shift from the FIGS to the LTRS position when the space bar is operated. Normally, however, the unshift-on-space feature of these teletypewriters is locked out. The adjustment necessary to include this feature, if required, normally will be made by authorized teletypewriter maintenance personnel only. The information below is included to explain the unshift-on-space feature when the teletypewriter is adjusted to include this facility.

b. Operation. (fig. 120) The teletypewriter

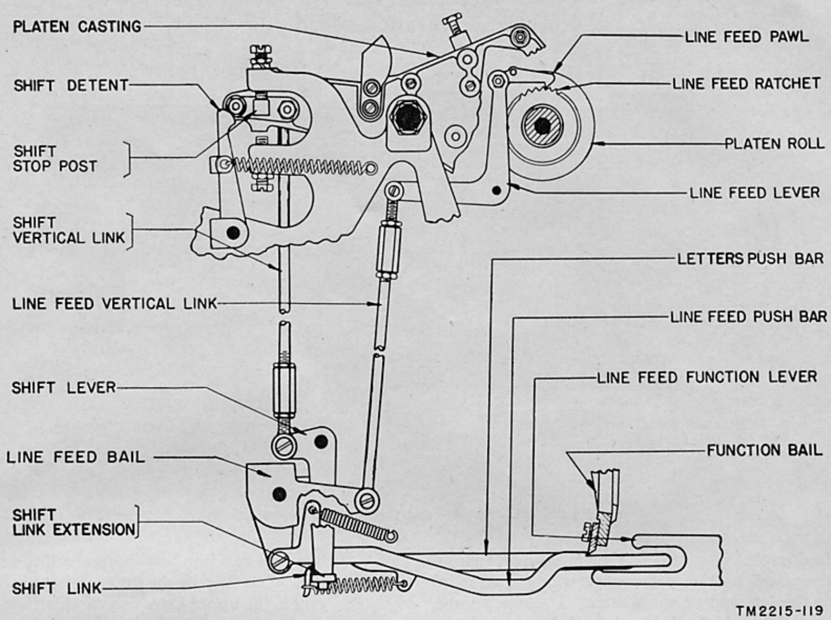

Figure 119. Platen-shift and line-feed mechanism.

shifts the platen from the FIGS to the LTRS position by the action of the space-function lever. When the unshift-on-space feature is not required, the unshift-on-space cut-out lever is moved into engagement with the space-function lever projection, and the space-function lever extension moves upward on a space combination and raises the LTRS push bar into the path of the function bail (fig. 119). The platen then shifts to the LTRS position.

104. Line Feed

a. Description and Purpose. The line-feed mechanism mechanically feeds the paper in the teletypewriter through a train of actions in response to the combination for LINE FEED received by the selector mechanism. When the first function lever on the left begins to move, motion is transmitted through the push bar, line-feed bell crank, vertical link, feed lever, feed pawl, and

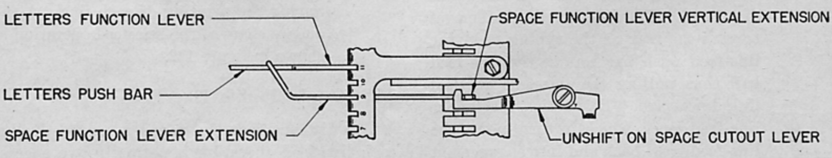

Figure 120. Unshift-on-space cut-out lever.

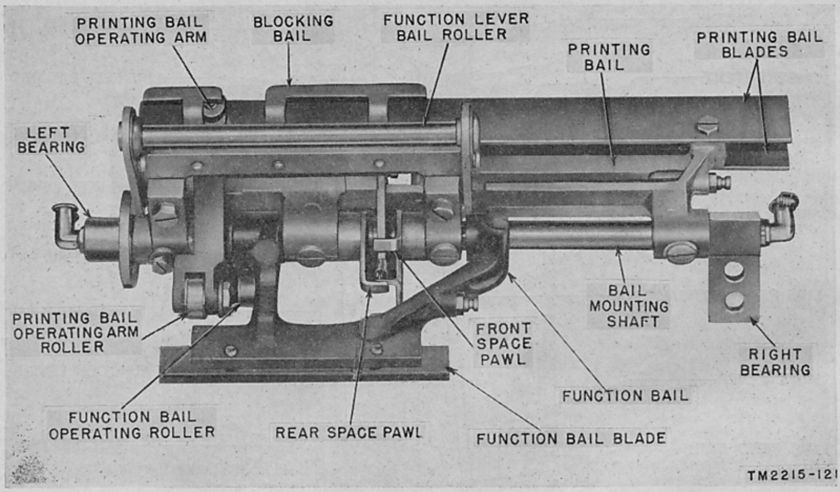

Figure 121. Printing- and function-bail assembly.

feed ratchet (fig. 119). The function bail moves the platen by the feed ratchet which is attached to the left end of the platen. The check lever, check lever shaft, check post, check screw, detent ratchet, and detent assembly are provided to maintain proper line interval when the paper feeds. The check lever, check lever shaft, check post, and check screw stop the turning of the platen. The detent ratchet, attached to the end of the platen, and the detent arm assembly hold the platen in printing position.

b. Operation.

(1) When the line-feed function lever, second from the left, is selected, its lower extension raises the line-feed push bar into the path of the function-bail blade (fig. 119). When the function bail moves toward the rear of the typing unit, the line-feed push bar rotates the line-feed bail thus pulling the line-feed vertical link downward. This action rotates the line-feed lever, which in turn moves the line-feed pawl back and into engagement with the line-feed ratchet, and thus rotates the platen one line space. When the line-feed function lever is returned to its normal position by the function-lever bail roller, the upper extension of this function lever will strip the line-feed push bar off the function-bail blade. The line-feed lever spring then returns the mechanism to its normal position and the line-feed push bar spring holds the line-feed push bar out of the path of the function-bail blade until the line-feed function is once again selected.

(2) After each line-feeding operation, a roller on the detent lever (fig. 104) locates itself between two teeth on a detent ratchet, thus regulating the space between lines, and holding the platen firmly in position during the printing of each line. A sequence chart of the line-feed operation is shown in figure 122.

105. Single-Double Line Feed

The distance that the paper is moved during each line-feed operation is normally two spaces. An adjustment is provided whereby the teletypewriter can feed single space if required.

LINE-FEED FUNCTION LEVER SELECTED

LINE-FEED PUSH BAR LIFTED INTO PATH OF FUNCTION BAIL BLADE

FUNCTION BAIL MOVES TOWARD REAR

LINE-FEED PUSH BAR OPERATES

LINE-FEED BELL CRANK ROTATES

LINE-FEED VERTICAL LINK MOVES DOWN

LINE-FEED LEVER OPERATES

LINE-FEED PAWL ENGAGES LINE-FEED RATCHET

PLATEN ROTATES 1 OR 2 LINES (DEPENDING ON
POSITION OF SINGLE-DOUBLE LINE-FEED LEVER)

BACKWARD MOVEMENT OF LINE-FEED PAWL OPERATES CHECK LEVER

LINE-FEED CHECK LEVER SHAFT ROTATES

LINE-FEED CHECK POST AND CHECK SCREW POSITIONED TO PREVENT OVERTRAVEL OF PLATEN

LINE-FEED DETENT ROLLER RESTS BETWEEN TWO TEETH
ON LINE-FEED DETENT RATCHET, HOLDING PLATEN PROPERLY CENTERED

FUNCTION LEVER BAIL RETURNS TO NORMAL POSITION

LINE-FEED FUNCTION LEVER MOVES BACK

UPPER EXTENSION OF LINE-FEED FUNCTION LEVER STRIPS
LINE-FEED PUSH BAR OFF FUNCTION BAIL BLADE

LINE-FEED MECHANISM RETURNS TO UNOPERATED POSITION

TL53917S

Figure 122. Sequence chart for line feed.

a. Description and Purpose. The line-feed ratchet is attached to the left-hand end of the platen (fig. 119). It is designed for either double- or single-line feed operation. The saw-tooth notches on the ratchet receive the adjustable line-feed pawl.

b. Operation. In its lower position, the single-double, line-feed lever allows the line-feed pawl to skip the first and engage the second tooth, resulting in rotation of the platen for a double space. When the single-double, line-feed lever is in its upper position, the line-feed pawl can engage only one tooth on the line-feed ratchet, thus resulting in the rotation of the platen for only a single space.

106. Paper Feeding

To facilitate paper feeding, a paper-straightener rod and a series of pressure rollers are used (fig. 112). The straightener rod guides the paper as it is unwound from the roll in response to the line-feed function. The rod moving under pressure is also used as a slack rod that prevents the paper from tearing. The pressure rollers hold the paper against the platen and prevent slippage when line feeding.

107. Signal Bell

a. Description and Purpose. The signal bell, mounted horizontally at the rear of the typing unit (fig. 124) provides an audible signal which is used to signal the operator. It is connected to its function lever by means of a hammer arm, operating lever, a latch bar, and a reset bar. The bell hammer will strike the signal bell once each time the BELL key (FIGS S) is pressed on any teletypewriter keyboard in the circuit.

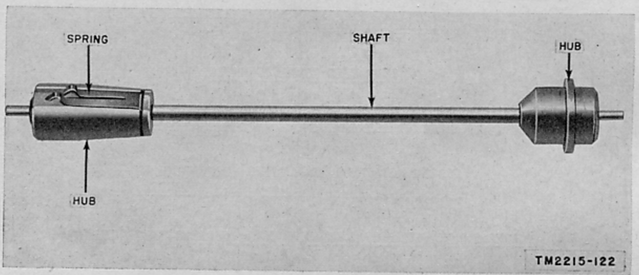

Figure 123. Paper spindle.

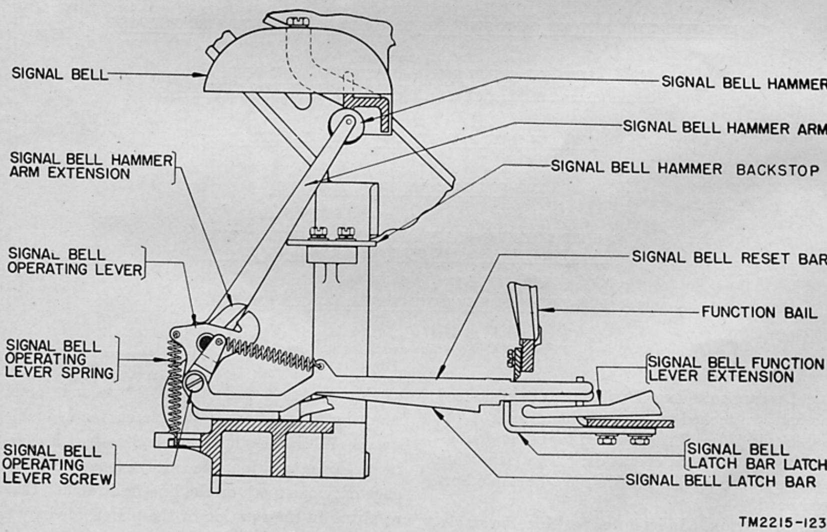

Figure 124. Signal bell mechanism.

b. Operation.

(1) When the bell function lever is selected, its extension (fig. 124) raises the bell-latch bar. This releases the bell operating lever, which is rotated by the spring connected to it, and strikes the bell-hammer arm extension causing it to throw the bell hammer against the bell.

(2) The bell-reset bar and bell-latch bar, both pivoting on the bell operating lever screw, are reset by the function bail as it moves to its rear position, and the blade engages the notch on the reset bar. A sequence chart illustrating the train of actions for the signal bell function is shown in figure 125.

BELL FUNCTION LEVER SELECTED
(PLATEN IN FIGURES POSITION AND SIXTH VANE UP)

BELL LATCH BAR UNLATCHES

BELL OPERATING LEVER ROTATES

BELL HAMMER STRIKES SIGNAL BELL

FUNCTION BAIL RESETS BELL RESET BAR AND BELL LATCH BAR

TL53918S

Figure 125. Sequence chart for signal bell.

108. Mechanical Motor Stop
(fig. 126)

This feature is included in Teletypewriter TT–5/FG and operates when the FIGS and then H keys are pressed on the keyboard. This feature is not included in Teletypewriter TT–6/FG.

a. Description and Function. The mechanical motor stop is a function operation on the teletypewriter. The motor-stop function lever (fig. 127) is selected when the STOP key (FIGS H) is pressed. The stop function stops the motor at the transmitting teletypewriter and all motor units of teletypewriters connected in the same signal circuit. All motors in the same circuit can be restarted by operating the SEND REC BREAK key of any teletypewriter in the circuit to BREAK, or otherwise opening the line circuit momentarily.

b. Motor Stop Operation.

(1) When the motor-stop function lever is selected, its motion forward causes its lower-rear extension to tip the motor-stop lever to the rear. This latches the inner motor-stop pawl onto the thicker part of its latch on the armature extension (fig. 127).

(2) Simultaneously, the front extension of the motor-stop function lever closes the left-hand motor-stop contacts. As the rear extension of the motor-stop contact lever moves up, the front extension moves down against its spring. This opens the right-hand motor-stop contracts.

(3) Since both pairs of contacts are wired in multiple, the motor will not stop until the motor-stop function lever is returned to its normal position and the left-hand contacts are again open. These contacts hold the motor circuit closed until the selector cam sleeve comes to rest, which assures the disengagement of the main shaft clutch and the disengagement of the locking lever from the locking wedge before the motor stops.

c. Motor Start Operation.

(1) To start the motors again, the line must be opened for a short interval by operating the SEND REC BREAK key to BREAK (fig. 130). This moves the upper contact extension against the line contact insulator. The line is opened, and the selector armature extension is moved down by the armature spring, disengaging the motor-stop pawl latch from the inner motor-stop pawl. The motor-stop lever (having traveled forward a short distance) is again stopped when its outer motor-stop pawl catches the cutaway portions of the motor-stop pawl latch.

(2) When the line signal circuit is closed again, the armature moves to its operated position, the outer motor-stop pawl unlatches the armature extension, and the motor-stop function lever returns to its normal position. The extension on the lower portion of the motor-stop function lever, which has been holding the motor-stop contact lever away from the right-hand stop contacts, will now permit the spring to move the front extension of the motor lever upwards, thus closing the motor-stop contacts.

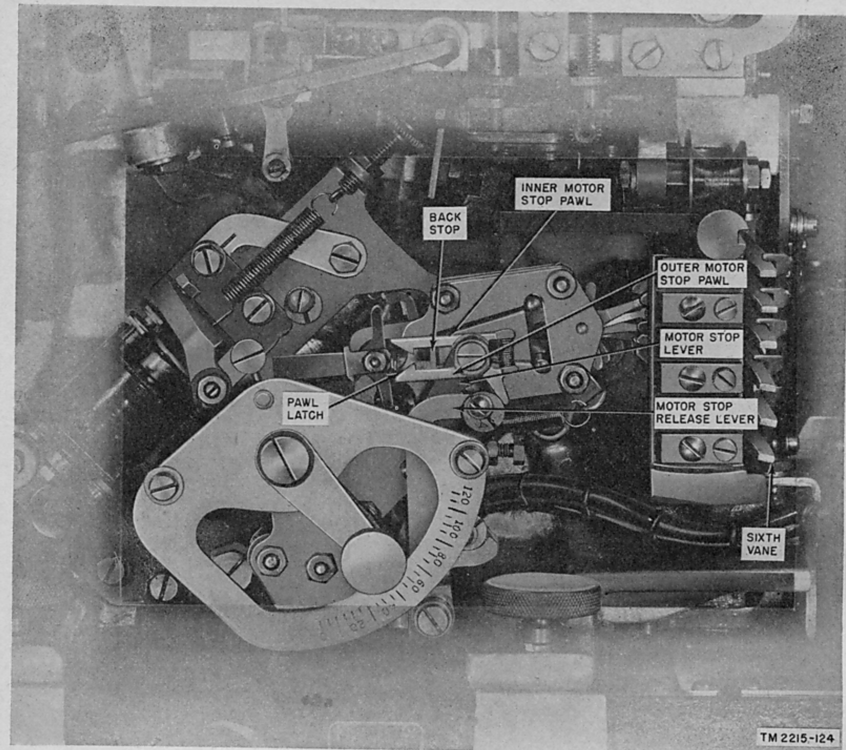

Figure 126. Mechanical motor stop.

d. Keyboard Locking Operation. When the motor-control function is operated, the forward end of the motor-stop function lever moves down against the lower screw on the reset lever and closes the keyboard-control contacts. This locks out keyboard transmission. The reset lever, in turn, moves the contact operating lever as described in paragraph 110*b*(5) and figure 128.

e. Motor-Stop Release Lever. The motor-stop release level eliminates the possibility of the selector cam sleeve coming to rest with the armature locking lever riding the low part of the cam (fig. 127). For example, immediately after FIGS H has been operated on the keyboard, and before the motor has come to a stop, if the line opens accidentally (thus releasing the selector magnet armature), the selector cam sleeve should rotate beyond the stopping point and it is possible that the armature locking lever might come to rest in an indent of its cam. With the cam stopped in this position, the armature extension is not free to respond to the next open line interval, thus making it impossible to operate the mechanical motor control. To avoid this condition, a mechanical arrangement is provided so that when the locking lever is in an indent of the locking cam, the motor-stop release lever is not permitted to latch onto

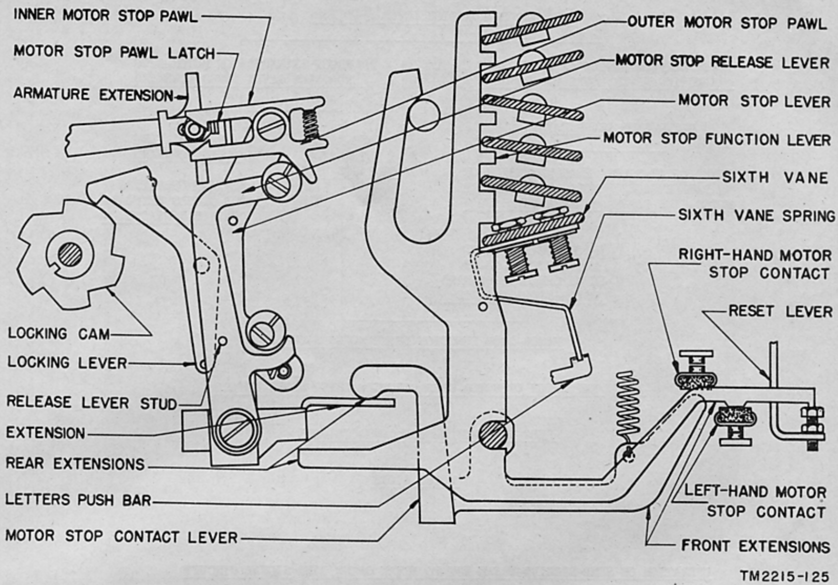

Figure 127. Mechanical motor-stop mechanism.

the armature-extension latch. This is accomplished by means of the motor-stop release lever. When the locking lever is in an indent it comes in contact with the release lever stud. This holds the eccentric at the upper end of the motor-stop pawl, preventing the pawl from engaging the motor-stop pawl latch. Thus, the motor-stop feature cannot function, the motor continues to revolve until the selector cam is stopped by the stop lever, and the locking lever rides the long high part of the cam. A sequence chart for the remote motor control function is shown in figure 129.

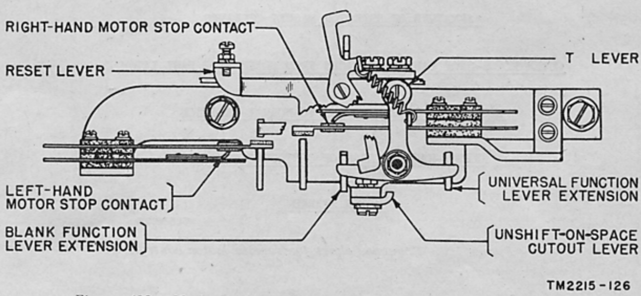

Figure 128. Mechanical motor-stop contacts (front of typing unit).

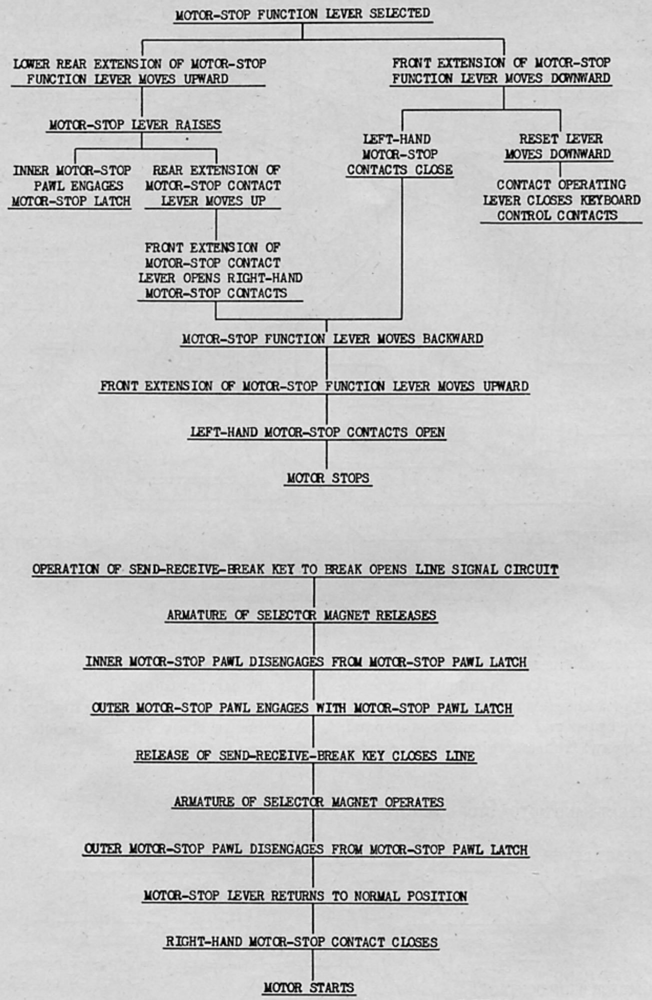

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Figure 129. Sequence chart for remote motor control.

109. SEND REC BREAK Key

a. Description and Purpose. The SEND REC BREAK key, which is mounted on the front left-hand corner of the base and extends through an opening in the typing unit cover, has three positions. As its name indicates, this key when operated to its SEND position arranges the equipment for transmission and also makes reception possible. With the key at the REC position, only reception is possible. The BREAK position is used to send break signals to a distant operator, or to start teletypewriters in the same circuit by momentarily opening the signal line, and thus to operate the remote motor-control mechanism (par. 108).

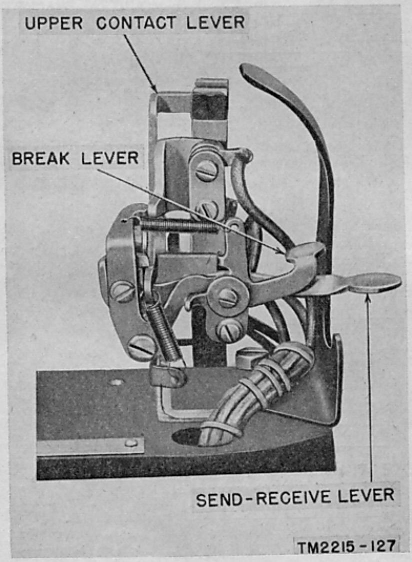


Figure 130. SEND REC BREAK key assembly.

b. Manual Operation. The SEND REC BREAK key can be moved to SEND or REC by moving the lever up or down. The latch lever stops the key in the REC position when it is being moved downward. To send a BREAK, the latch lever must be operated, thus releasing the key and permitting it to be moved to BREAK. When the key, which is held at BREAK, is released, it will return to its REC position.

c. Mechanical Operation. The SEND REC BREAK key can be moved to the REC position by operating the blank key of the keyboard twice in succession. On Teletypewriter TT–5/FG the blank key will operate in either the FIGS or LTRS position. On Teletypewriter TT–6/FG the blank key sends a dash from the FIGS position, but it is not equipped with the motor-stop mechanism so it will not move the SEND REC BREAK key to REC when the blank key is selected twice in succession.

110. Blank Function (Keyboard-Transmitter Locking Mechanism)

a. Description and Purpose. The keyboard locking mechanism is composed of a set of six contacts. In addition, there are the upper and lower contact levers, the contact lever spring, the SEND REC BREAK levers, the latch lever, and the stop lever plate. These elements of the mechanism are mounted on the front left-hand corner of the base as shown in figure 137. The SEND REC BREAK key, when operated to REC by two successive operations of the blank key on the keyboard, closes the keyboard control contacts and short-circuits the sending contacts of all teletypewriters in the circuit. No teletypewriter in the same circuit can send until the key is restored to SEND. The procedure outlined above also serves as a break-in feature that permits any receiving operator to stop transmission from a remote station in the same circuit, whether the transmitting equipment is sending from tape or manually from a keyboard. A tape transmitter, if used, may be controlled from the lower contacts of the SEND REC BREAK mechanism.

b. Mechanical Operation.

(1) As the blank-function lever moves forward its extension moves downward carrying with it the left arm of the T lever.

(2) As the left arm of the T lever is moved down, the reset lever and the intermediate lever move to the left. This positions the lower end of the intermediate lever against the side of the blank-function-lever extension where it is held by a spring.

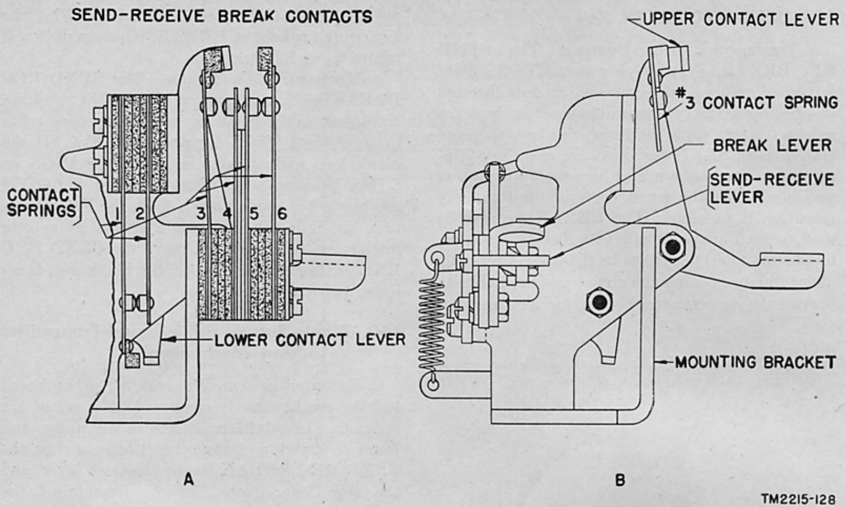


Figure 131. SEND REC BREAK key.

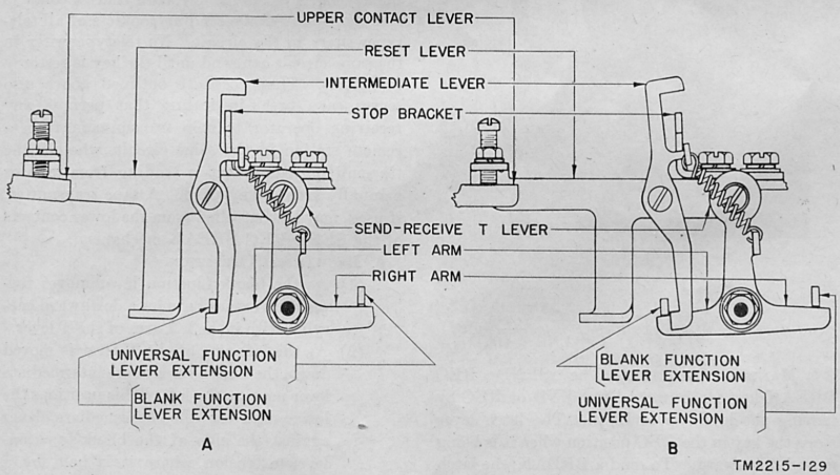


Figure 132. Typing unit parts of SEND REC BREAK mechanism.

(3) The blank-function-lever extension moves upward when the function-lever bail returns to its normal position. The toe of the intermediate lever is thereby permitted to come under the blank-function extension by tension of the intermediate lever spring.

(4) The blank key, when pressed the second time, causes the blank-function lever to move downward again, carrying the intermediate lever with it.

(5) As the intermediate lever moves downward, it moves the reset lever downward. This also moves the right arm of the operating lever (upper contact lever) downward and positions its upper contact arm to the right.

(6) The movement of the upper arm of the operating lever to the right allows the keyboard control contacts to close because of the tension of the contact spring. At the same time, the operating pawl is released and its spring moves the SEND REC BREAK key to its REC position.

(7) As the printing-bail operating-arm roller rides the high portion of the printing-bail cam, the function-lever bail moves upward. This causes the function-lever-bail roller to engage the cam surface of the rear arm of the blank-function lever, moving it out of engagement with the vanes. The blank-function lever is returned to its normal position, and operation of the blank function is thus completed. A sequence chart illustrating the above operations is shown in figure 133.

c. Manual Operation. Manual operation of the SEND REC BREAK key to lock-out keyboard operation is described in *a* above.

111. Polar-Neutral Key

a. Description and Purpose. The polar-neutral key is a two-position key mounted on top of the keyboard of the keyboard-transmitter (fig. 134). Its purpose is to enable the teletypewriter to respond to either polar or neutral signals.

b. Operation. Refer to figures 134 and 135 for operation of the polar-neutral key. It will be seen that pushing the polar-neutral key in will result in the circuit opening through the relay bias winding (terminal Nos. 2 through 7), permitting the relay to respond to polar type signals. Pulling the key out connects the bias winding into the rectifier circuit for reception of neutral signals.

112. Ribbon Lock-Out

The ribbon lock-out (fig. 105) can be included when the teletypewriter is to be used to cut stencils. When the ribbon lock-out bar is moved in, it engages the ribbon-oscillator extension. This holds the oscillator assembly in its lower position below the printing line, and prevents its motion in line with a type-bar pallet. Thus, the type-bar pallets are permitted to strike the stencil without striking the ribbon.

113. Electrical Circuits (General)

The electrical circuits of Teletypewriters TT–5/FG and TT–6/FG are considered in three main groups: power circuits, signal circuits, and local circuits. Power circuits consist of the wiring at the table and in the operating components, by which a-c is applied to the rectifier power unit and the motors. Signal circuits are those used to carry the signal impulses which conduct communication. Local circuits are those by which d-c is applied to the selector magnets, relay bias winding, and test circuits. In the following paragraphs the electrical circuits are traced from the terminal or connection points at the table to each of the electrical assemblies in the operating components. The rectifier power unit is discussed in paragraph 120; also refer to wiring diagrams in the back of this manual and to paragraph 114.

114. Table

a. General. The electrical service assembly in the table is wired so that a-c is connected to the rectifier, d-c is distributed from the rectifier to the various local circuits, and signal lines are connected to the transmitter contacts and relay line winding, in series, through appropriate terminal boards. In *c*, *d*, and *e* below, the a-c, d-c, and signal circuits are considered separately.

b. Power Circuits. In this discussion reference is made to figure 143 (the schematic wiring diagram) of the electrical service assembly in the table. The power, line, and local test circuit terminal boards in figure 143 are made of insulating material and contain 12 screw-type terminals, which are numbered 1 through 12. From these

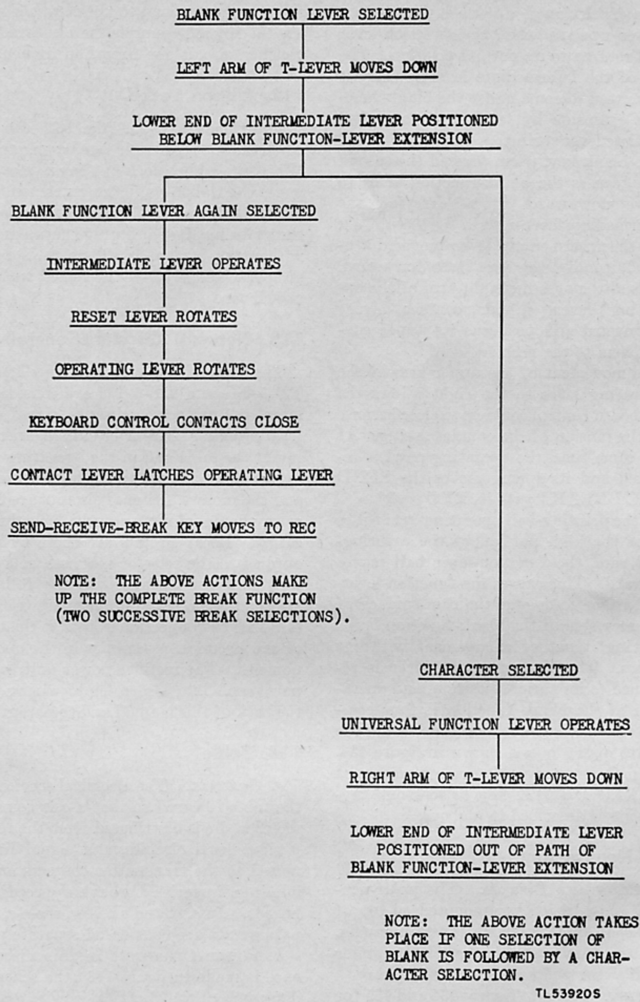


Figure 133. Sequence chart for blank function.

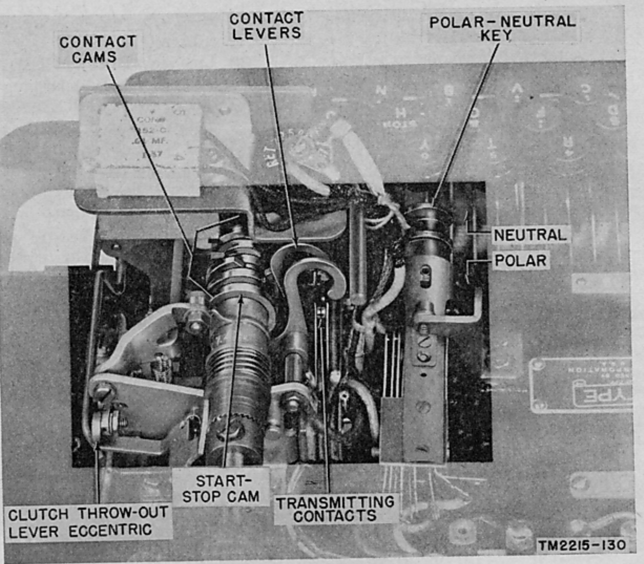


Figure 134. Keyboard mechanism.

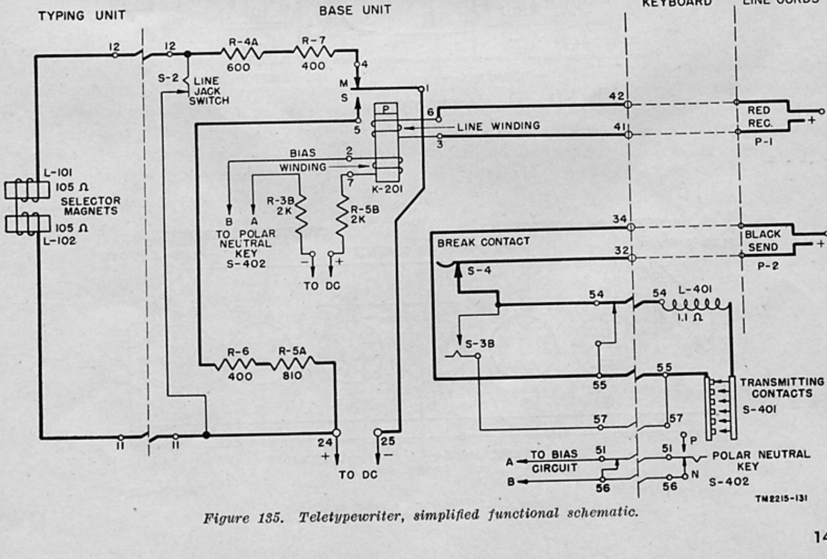


Figure 135. Teletypewriter, simplified functional schematic.

terminal boards wiring is arranged to connect each outlet or receptacle, under the table top facing the front of the table, into its appropriate circuit. The signal circuits are completed through terminals No. 7, 8, 9, and 10 (fig. 143). The various outlets and receptacles (fig. 136) are arranged on the table (electrical service assembly) as follows:

(1) A—Four-contact plug to receive adjusted terminal a-c motor voltage from rectifier power unit (Rec–29 only).

(2) B—Two-contact receptacle furnishing a-c to rectifier power unit.

(3) C—Four-contact receptacle for teletypewriter a-c motor plug.

(4) D—Three-contact receptacle to furnish d-c to teletypewriter plug for relay bias circuit.

(5) E—Three-contact plug to receive d-c from rectifier.

(6) Line jacks BLK and RED. BLK receives the black-shelled send plug from the teletypewriter, and RED receives the red-shelled receive plug to the teletypewriter.

(7) Test jacks BLK and RED receive the send and receive plugs of the teletypewriter when making a local test of teletypewriter operation.

Note. The fuse and the convenience outlet receptacle of the teletypewriter are shown in figure 282. The rectifier circuit is shown in figure 281.

c. A-C Circuits (fig. 143). Incoming a-c power conductors are connected to terminals No. 1 and 2 of the table. Alternating current is connected to the rectifier power unit through a-c out-

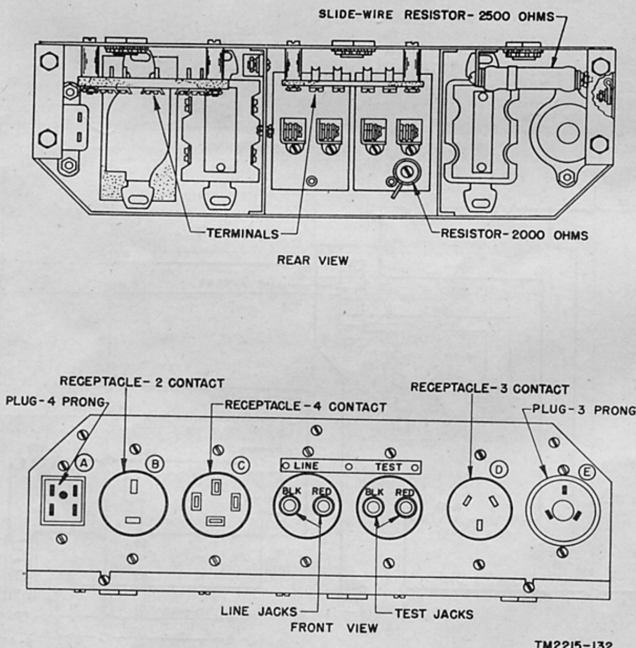


Figure 136. Electrical service assembly.

let B (fig. 136). The rectifier power unit, in addition to supplying d-c, also is used to adjust the incoming a-c line voltage to the proper value required by the motor units. This adjusted a-c motor terminal voltage of the Rec–29 rectifier is delivered to plug A (fig. 136). The schematic diagram (fig. 281) shows the circuit to which the motor unit is connected, as well as the associated receptacle or outlet. Note that the motor circuit has a switch and fuse.

d. D-C CIRCUITS. Filtered d-c supplied by the rectifier power unit is connected to terminals No. −11 and No. +12 of the table. The conductors of the d-c power cord from the teletypewriter power block terminate in a plug that is inserted in power receptacle D of the table (fig. 136). From the power block, the d-c circuit may be traced (figs. 282 and 283) to the transmitting contacts of the keyboard-transmitter and to the selector magnet of the typing unit. In addition, d-c also is supplied to the relay bias winding through the relay block and slip contacts 52 and 53 of the base. Furthermore, d-c can be supplied to the signal lines, if required, and to the local test circuit of the table. The necessary connections to the d-c source, when line current is supplied, are given in paragraph 20. The 2,000-ohm resistor and the 2,500-ohm resistor (fig. 151) are provided to adjust the line current of the test and signal circuits, respectively.

e. SIGNAL CIRCUITS. Figure 143 shows the conductors of the signal circuits connected to the line terminal board of the table. The signal circuits are then brought to the jacks of the jack block (fig. 136) into which the cords from the send and receive blocks of the teletypewriter base are plugged. The teletypewriter send block is usually designated as the 30 block of the base and the receive block as the 40 block.

115. Base

a. GENERAL. The base has four terminal boards and the line relay mounting, arranged as shown in figure 137. Three of these terminal boards are located at the right front corner of the base. The fourth terminal board is near the relay mounting at the left rear corner. Usually, each terminal board is identified by the numbers of the terminals it contains. Thus the terminal board Nos. 21 through 26 is called the 20 block and is used to connect the power conductors to the motor unit. The terminal board Nos. 31 through 36 is called the 30 block. To this block are connected the conductors from the transmitter contacts of the perforator-transmitter or any other transmitting unit with this equipment. The terminal board Nos. 41 through 46 is called the 40 block and the conductors from the selector magnet usually are connected to this block. The terminal board Nos. 61 through 66 is called the 60 block and the conductors from the polar relay are connected to this block. In the subparagraphs below, the circuits are traced from each of the terminal boards mentioned above.

b. 20 BLOCK. The 20 block is called the power block. Conductors from the a-c power cord (which is plugged into receptacle C (fig. 136) of the table) are connected to terminals No. 21 and 23. The wires of the d-c cord (plugged into receptacle D (fig. 136) of the table) are connected to terminals No. 24 (+) and 25 (−).

(1) *A-c connections.* In figure 283 note that a convenience outlet is connected between terminals No. 21 and 23, and that the power circuit to the motor is completed through the slip contact Nos. 13, 14, 15, and 16 of the motor unit mounting. This switch connects the motor control contacts, in series with the fustat and the two 300-ohm resistors in the lead from terminal No. 22 to slip contact No. 14 of the motor unit mounting (fig. 282). The 5-ohm resistor and the 1-μf (microfarad) capacitor between the switch and the midpoint between the two 300-ohm resistors are used to cut down excessive sparking across the switches and contacts of the motor circuit. From the midpoint between the two 300-ohm resistors, a lead connects to slip contact No. 16 for the field winding of the motor. Figure 152 shows the motor circuit and the electrical relation of the circuit constants.

(2) *D-c connections.* The d-c leads from terminals No. 24 and 25 are connected to slip contact Nos. 52 and 53 of the keyboard-transmitter and to terminals No. 62 and 63 of the 60 block. From terminal No. 62 a lead is connected to terminal No. 46 to which one lead from the selector magnet is also connected. The other lead from the selector magnet is connected to

terminal No. 45 of the 40 block from which a connection is made to terminal No. 65 of the 60 block. The circuit constants of the selector-magnets circuit are shown in figure 135. Note in this figure that d-c from terminals No. 24 and 25 of the 20 block is used to energize the selector-magnet circuit. Figure 135 shows the selector-magnet shunt circuit with its constants, and both circuits may be traced on figure 282.

c. 30 BLOCK. This block is called the send block, from which signal line conductors are connected to terminals No. 32 and 34. Figure 135 shows the constants of the transmitter circuit. Note that connections between terminals No. 33, 34, 35, and 36 of the 30 block lead to terminals No. 69, 70, 68, and 67 on the resistor block, respectively. Flat type resistors may be used to adjust line current if necessary. When such an adjustment is made, the flat type resistors are inserted in the resistor block and connected as shown in figure 282. Normally, line current will be adjusted at the station supplying it or at the line resistors (fig. 143) located behind the jack blocks of the table.

d. 40 BLOCK. This terminal board is usually referred to as the receive block, from which signal line conductors are connected to terminals No. 41 and 42. These terminals are wired to terminals No. 61 and 66, respectively, on the 60 block (fig. 155). Conductors from the selector magnet are connected to terminals No. 45 and 46 of this block, and from there they are completed as described in *b* (2) above and figure 45.

e. 60 BLOCK. This is the terminal board which is located at the left rear corner of the base and is usually referred to as the relay block (fig. 160) where the various relay circuits are completed. Figure 135 illustrates the bias cricuit, the selector magnet circuit, the shunt circuit, and the relation of the relay line (operating) winding to the signal circuit.

116. Polar Relay (Including Keyboard-Transmitter Contacts and Typing Unit)

a. GENERAL. The typing unit contains the selector mechanism of which the selector magnet is the most important element. The transmitter contacts of the keyboard-transmitter usually will be connected in series with the relay line winding to obtain local copy of all transmitted messages. The mechanical sequence of operation of the keyboard and transmitter mechanism is contained in paragraph 70. The electrical operation of the keyboard transmitting mechanism is described in paragraph 66. In this paragraph the discussion is confined to the electrical operation of the transmitting and receiving components, the line relay, and the motor unit. The circuits of these teletypewriters may be divided into separate related circuits. These are:

(1) Bias circuit of the WECo 255–A type relay.
(2) Line circuit.
(3) Selector-magnet circuit.
(4) Selector-magnet shunt circuit.
(5) Motor circuit.

b. RELAY BIAS CIRCUIT.

(1) *Purpose.* The purpose of the bias circuit is to pull the line-relay armature to the spacing contact, magnetically, when a neutral (no current) spacing impulse is received from the line. The line relay reacts as if a spring attached to it on the spacing side were pulling the armature to the spacing contact.

(2) *Circuit constants.* The bias circuit of the line relay is a simple series circuit composed of the relay bias winding (fig. 135), two 2,000-ohm resistors, and contacts Nos. 2 and 3 of the polar-neutral key. The two 2,000-ohm resistors plus the resistance of the bias winding (approximately 136-ohms) limit the current to approximately 30 amperes. The polar-neutral key opens the circuit for polar operation and closes it for neutral operation. Therefore, the bias circuit is used only for neutral operation. The bias circuit requires approximately 115 volts dc, which is applied through terminals No. 24 and 25 of the 20 block.

(3) *Circuit tracing.* When tracing the bias circuit (fig. 282) begin at the positive terminal (No. 24 on the 20 block) and continue through spring contact No. 52, to terminal No. 62 on the 60 block, through the 2,000-ohm resistor, to terminal No. 7 of the winding of the relay, to terminal No. 2 of that winding, to contact No. 56, to terminal No. 3 on the polar-

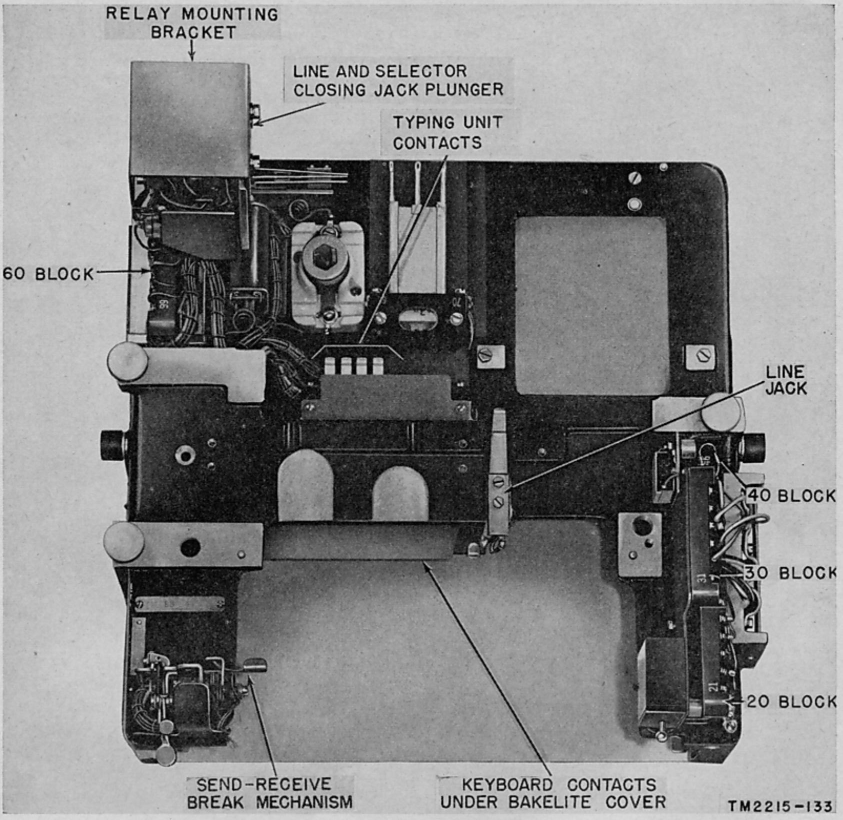


Figure 137. Base unit.

neutral key, to terminal No. 2 of that key, to slip contact No. 51, through the 2,000-ohm resistor connected to terminal No. 63, to contact No. 53 and out to negative terminal No. 25 on the 20 block.

c. Line Circuit.

(1) *Purpose.* The purpose of the line circuit is to control the operation of the line relay in its transition from spacing to marking. This transition occurs in response to the spacing and marking impulses generated by the transmitting contacts, which open and close the line, respectively.

(2) *Circuit constants.* The line circuit is composed of the operating or line winding of the relay, the transmitting contacts, the send-receive-break mechanism, and the line-resistance mounting when the flat type line resistors are used. For simple neutral operation the signal line may be connected to terminal No. 32 of

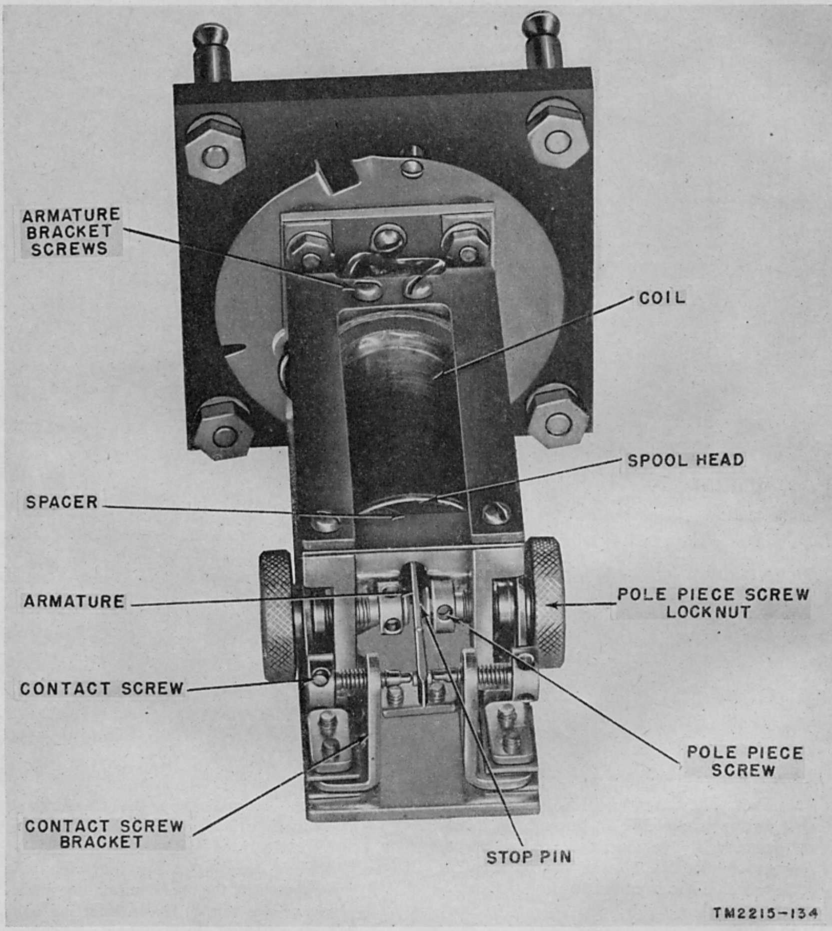


Figure 138. Ry–30 (WECO type 255–A) line relay

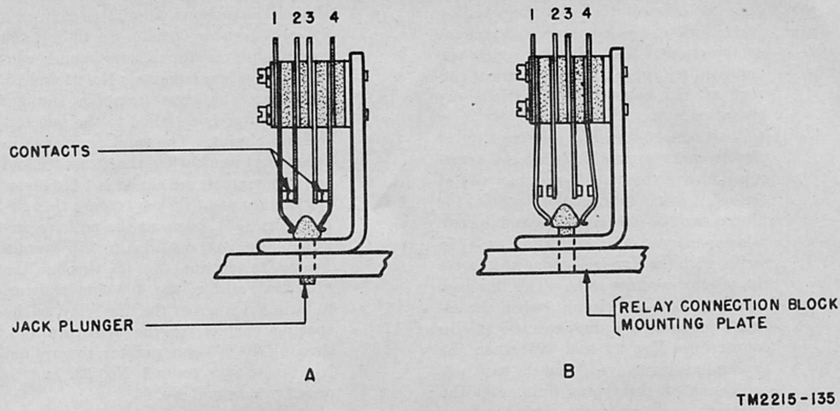


Figure 139. Jack for closing line and selector circuits when relay is removed.

the send block and No. 42 of the receive block, terminal No. 34 and 41 being connected by a suitable strap or jumper. When flat-type line resistors are required, terminals No. 33 and 36 are strapped and the connecting strap between terminals No. 34 and 41 is transferred to terminals No. 35 and 41. Teletypewriters TT-5/FG and TT-6/FG normally will be arranged as shown in figure 45 with the transmitter contact connected in series with the relay line winding, by effecting the connections required at line terminals No. 7, 8, 9, and 10 of the table. One of the send terminals will be strapped to one of the receive terminals and the two terminals remaining will be connected to the line (fig. 143). For this application one wire of the line is connected through a line terminal to one side of the send jack, and the send plug, through the transmitter contacts, back to the other side of the send plug, send jack, and send terminal. From there it is strapped over to one of the receive terminals of the table, to one side of the receive jack and plug, through the relay winding, back to the other side of the receive plug, jack, and terminal, and then to the other wire of the line. When necessary to supply line current, connections are made at the line terminal boards as shown in figure 143, and the line resistors (fig. 45), are adjusted for proper line current. The ground may be used in place of one of the wires of a pair between teletypewriter stations (ground return).

(3) *Transmitting contacts shunt circuits.* The shunt contacts (Nos. 3 and 4), part of the break contact assembly, are wired across the transmitting contacts, and lock the keyboard when they are closed.

(4) *Circuit tracing.* The circuit may be traced for simple neutral operation (fig. 282) from terminal No. 32 to the break contacts, through these contacts to slip contact No. 54, through the transmitter filter-unit coil to the transmitter contacts, continuing to slip contact No. 55, to terminal No. 34, to terminal No. 41, to terminal No. 61, through terminal No. 3, to No. 6 of the line-winding of the relay, to terminal No. 66, and finally to terminal No. 42.

d. Selector-Magnet Circuits.

(1) *Purpose.* The purpose of the selector-magnet circuit (fig. 135) is to receive the marking and spacing impulses from the polar line relay (WECo type 255-A),

and to control the electromechanical transitions of the marking and spacing combinations. The selector-magnet circuit requires approximately 60 ma of current at 110 volts d-c for satisfactory operation.

(2) *Circuit constants.* The selector-magnet circuit consists essentially of the armature (1) and the marking contact (4) of the relay, a 400-ohm resistor (part of the filter), two 600-ohm resistors, and the two selector-magnet coils (105 ohms each) in series, with the line jack connected across the selector-magnet coils. The line jack serves to close the circuit (when the selector magnets are disconnected at slip connections Nos. 11 and 12) when the typing unit is removed from the base. A projection on the typing unit holds the line jack open when the typing unit is mounted on the base.

(3) *Circuit tracing.* Trace the selector-magnet circuit from positive terminal No. 24, to slip contact No. 52, terminal No. 62, terminal No. 46, to slip contact No. 11 (one side of the line jack), through the selector-magnet coils to slip contact No. 12 (the other side of the jack); continue to terminal No. 45, terminal No. 65 through the 600-ohms resistor, through the 400-ohm resistor (part of the filter) to No. 4 of the line relay, to the marking contact, through the armature (1) of the line relay, through the 600-ohms resistor, to terminal No. 63, to terminal No. 53, and finally to negative terminal No. 25.

e. Selector-Magnet Shunt Circuit.

(1) *Purpose.* The purpose of the selector-magnet shunt circuit (fig. 135) is to keep the rectifier output constant across the terminals (No. 24 and 25) which connect dc to the equipment. This serves as a protection for the old style vacuum tube rectifier by equalizing the load on the power source, whether the armature is at marking or at spacing. The selector-magnet shunt circuit requires approximately 110 volts dc and 60 ma.

(2) *Circuit constants.* The shunt circuit consists of a 600-ohm resistor and the line relay armature (these are common with the selector-magnet circuit) (*d* above), a 400-ohm resistor (part of the filter), and an 810-ohm resistor in series, and is connected to power terminals No. 24 and 25, which are the same terminals through which power is supplied to the selector-magnet circuit. The total resistance in the shunt circuit when the armature and spacing contacts are closed is 1,810 ohms.

(3) *Circuit tracing.* When tracing this circuit (fig. 155), begin at the positive terminal (No. 24), continue to slip contact No. 52, to terminal No. 62, through the 810-ohm resistor, the 400-ohm resistor, to terminal No. 5 of the line relay, to the spacing contact, to the armature (1), through the 600-ohm resistor, to terminal No. 63, to slip contact No. 53, and to negative terminal No. 25.

117. Motor Circuit
(fig. 282)

a. Purpose. The purpose of the motor circuit is to furnish power (110-volt, 60-cycle ac) to the teletypewriter motor.

b. Circuit Constants. The motor circuit consists of two 300-ohm resistors, a power switch, a 1-μf capacitor, a fuse, a 5-ohm resistor, the mechanical motor-stop contacts (on Teletypewriter TT–5/FG only), and the motor. The two 300-ohm resistors are used in either series or parallel. The 1-μf capacitor and the 5-ohm resistor constitute a filter which is used to reduce excessive sparking across switches and contacts of the motor circuit. A target lamp and switch (slip contact Nos. 13 through 15) are included in the circuit.

c. Circuit Tracing. The circuit may be traced from terminal No. 21, continuing to the plug fuse, to the power switch, to slip contact No. 10, through the right pair of motor-stop contacts (except on Teletypewriter TT–6/FG), to slip contact No. 9, to terminal No. 22, to the 300-ohm resistor block, to slip contact No. 15 (which is shorted to slip contact No. 14, thus connecting the two 300-ohm resistors in parallel), to one side of the 300-ohm resistors, through the motor-unit filter coil, through the governor contacts, to terminal No. 16, through the field winding of the motor, through the motor armature, to slip contact No. 13, and finally to terminal No. 23. When the motor turns too rapidly, which causes the governor contacts to open, the short circuit across the resistance is

opened. Current then flows from slip contact No. 14 through the two 300-ohm resistors in parallel, to slip contact No. 16, to the field winding of the motor, to the armature, to slip contact No. 13, and finally to terminal No. 23. The reduction in current caused by the change in resistance slows down the motor sufficiently to allow the governor contacts to close and thus restore the short circuit across the resistance.

118. Control Relay
(fig. 140)

The motor on a teletypewriter can be controlled by the control relay if it is connected into the motor circuit and then actuated from a remote, manually operated switch. This relay controls the operation of contacts which in turn may be used to start and stop the motor. Refer to the wiring diagram (fig. 283).

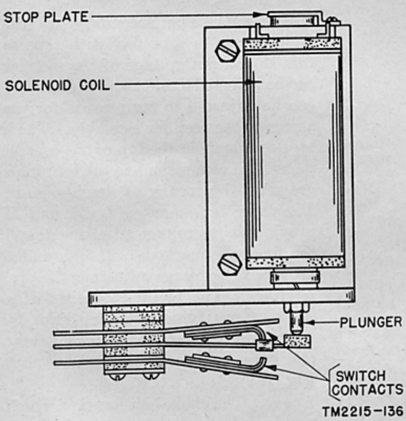


Figure 140. Control relay.

119. Miscellaneous Circuits

a. Line Relay Filter. A radio induction suppressor is used to cut down the r-f (radio-frequency) induction that is due to the low-contact pressure and small contact area of the WECo type 255-A relay. At the same time, a satisfactory lift for the relay contacts is assured through minimizing the tendency of the shunt capacities of the filter to cause contact build-up and erosion. Since the circuit conditions in which the line relay contacts operate permit the use of series resistances, a satisfactory suppressor unit, using a 400-ohm resistor as the series element and 1-μf capacitors as the shunt elements, is used. A 1-μf capacitor provides a bypass to ground, which in this case is the frame of the teletypewriter.

b. Spark-Killing Circuits.

(1) *Purpose.* The purpose of the spark-killing circuits across the M (marking) and S (spacing) contacts of the line relay is to prevent overheating and burning of the contacts caused by arcing when the contacts open or close.

(2) *Spacing* (fig. 155). The spark-killing circuit for the spacing contact is from one side of the .25-μf capacitor, through terminal No. 64, through the 2,000-ohm resistor, the 600-ohm resistor to terminal No. 65, to terminal No. 45, through the selector magnets, to terminal No. 46, to terminal No. 62, through the 810-ohm resistor, the 400-ohm resistor, to terminal No. 5 of the relay, to the spacing contact, the relay armature, through terminal No. 1 of the line relay, to the 600-ohm resistor, to the other side of the .25-μf capacitor.

(3) *Marking* (fig. 155). The spark-killing circuit for the marking contact is from one side of the .25-μf capacitor to terminal No. 64, through the 2,000-ohm resistor, through the 400-ohm resistor, to terminal No. 4 of the relay, to the marking contact, the relay armature, terminal No. 1 of the relay, to the 600-ohm resistor, to the other side of the .25-μf capacitor.

c. Sending Contact Filter Unit. This filter unit (fig. 154) usually consists of a retardation coil as the series element and a shunt capacitance, in addition to a capacitor, as a bypass to the teletypewriter frame. This filter performs the same purpose across the transmitting contacts as the line-relay filter performs across the relay contacts.

d. Remote Motor Control. This feature (fig. 126) is found in Teletypewriter TT-5/FG but not in Teletypewriter TT-6/FG.

(1) *General.* The remote motor-control feature is arranged to start the machine when the circuit is closed after an open signal. Two motor-stop pawls, which

latch on the armature extension, keep the motor circuit open when the machine is stopped (fig. H, STOP). When the circuit is opened, one of the pawls unlatches; when the circuit is again closed the other pawl unlatches, permitting the motor-stop release lever to move and close the power circuit.

(2) *Electrical features.* As part of the remote motor control arrangement, two sets of contacts are provided. These are wired in parallel in the motor unit power circuit (fig. 152). The right-hand set of contacts as seen from the front of the teletypewriter completes the circuit to the motor. The left-hand set of contacts is normally open during operation of the machine. When the stop-function lever is selected, the left-hand contacts close immediately, while an instant later the right-hand contacts open. The motor will continue to run because the power circuit to it is closed through the left-hand contacts. The left-hand contacts will not open until the locking lever rides the high part of the cam long enough to allow the motor-stop pawls to latch reliably on the armature extension.

120. Rectifiers

a. Rectifier REC–29.

(1) *General.* The Rec–29 rectifier is designed to provide d-c suitable for signal line battery as well as local battery, and to provide the proper a-c voltage for the operation of governed-series motors, when the rectifier is operated from a-c sources of various voltages and frequencies.

(*a*) *Input.* The input requirements are 95- to 125- or 190- to 250-volts, 25- to 60-cycle, single-phase a-c.

(*b*) *Output.* The output rating is as follows:

1. D-c. 0.2 ampere at 120 volts d-c. (No-load voltage of a new rectifier should not exceed 135 volts.)

2. A-c. A-c at suitable voltage (generally 115 volts) for the operation of one or two governed-series motors at any frequency from 25 to 60 cycles.

(2) *Components.* The rectifier consists essentially of a transformer, a full-wave selenium rectifying assembly, a variable choke coil with capacitor, a bleeder resistor, a filter capacitor, terminal panels, input and output fuses, input power switch, input cord with plug, and output cords with receptacles.

(*a*) *Primary.* The primary winding of the transformer has two sets of taps which terminate on the control panel.

1. One set of taps (terminating on the left-hand side of the control panel) provides for input voltages of 95, 105, 115, 125, 190, 210, 230, and 250 volts.

2. The other set of primary taps (terminating on the lower right-hand side of the control panel) provides the proper voltage for motor operation on 25-, 40-, 50-, or 60-cycle a-c.

(*b*) *Secondary.* The secondary of the transformer is provided with taps so that the output voltage of the rectifier can be adjusted to suit requirements and can be adjusted to compensate for the aging of the rectifier assembly. These taps terminate at the top of the control panel, and connections to the terminals are made by means of flexible leads. The three taps marked L, M, and H provide coarse voltage adjustment, and the five taps marked 1, 2, 3, 4, and 5 provide fine voltage adjustment.

(*c*) *Rectifier.* The rectifier consists of a stack of rectifying selenium disks divided into four sections by terminals at the ends, quarter-points, and center (fig. 141).

(*d*) *Choke.* The choke coil has taps which terminate on the upper right-hand corner of the control panel. These taps provide a means for adapting the filter to the frequency of the power supply and are utilized by connecting the flexible lead from the tuning capacitor to the tap corresponding to the input frequency.

(*e*) *Rear panel.* The input and output cords terminate on the panel at the rear of the rectifier. When the double-pole,

ON-OFF switch (located on the front panel) is in the OFF position, both sides of the input line are disconnected from the entire rectifier assembly (with the exception of the rear panel on which the input cord terminates). The cover must be removed to gain access to the terminals on the rear panel.

(3) *Operation.*

(*a*) *Transformer.* The primary winding of the transformer is connected through a 3.2-ampere fuse, an ON-OFF, double-pole switch, and cord and plug assembly to the a-c source of power. Taps on the primary winding suitable for the different input voltages are connected to the line by means of a flexible lead. In addition to its function as the transformer primary winding, this winding also functions as an auto-transformer for supplying 115-volt, a-c power through the a-c output cord for the motor. A .3-ampere fuse is provided in one leg of the d-c output circuit of the transformer to protect the rectifier and transformer in case of overload in the rectifier circuit. The secondary winding furnishes a-c power to the rectifier disks. By decreasing or increasing the number of turns to be used in the secondary winding, and by means of the L, M, H, and 1, 2, 3, 4, 5 adjustment taps on the secondary winding, the d-c output from the rectifier may be adjusted to the required 0.2-ampere at 120 volts regardless of the a-c applied to the input plug or obtained from the a-c output receptacle. As the rectifier ages, the voltage drop decreases. Adjustment of the rectifier to compensate for aging is made by means of the adjustment taps. When the H and 5 taps must be used to adjust the rectifier to an output of 0.2 ampere through 600 ohms at 120 volts, the rectifier should be taken out of service.

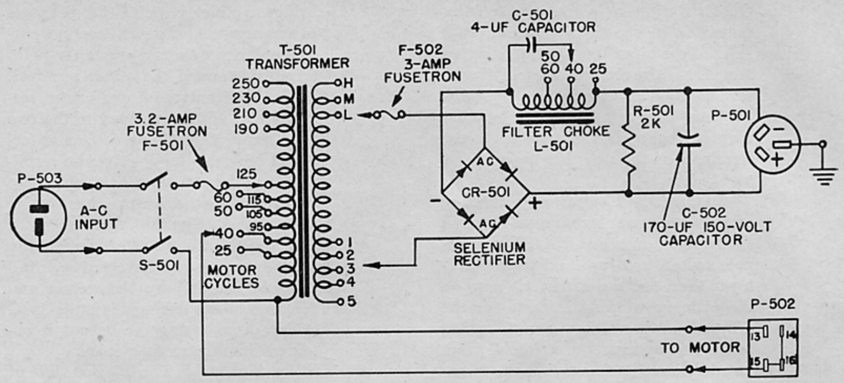
(*b*) *Rectifier* (fig. 141). The terminals at the ends, quarter-points, and center of the stack of rectifying selenium disks are connected to form a full-wave bridge rectifier circuit; the disks are so arranged that they will conduct current only from the end or quarter-point terminals toward the center terminal. With a-c from the transformer secondary winding connected to the two quarter-point terminals, the center terminal becomes the positive d-c terminal, and the end terminals which are connected together become the negative d-c terminal. Current is carried by the first and third sections of the rectifier stack during one half cycle of each full cycle of a-c and by the second and fourth sections during the other half-cycle. A pulsating d-c output is obtained from the rectifier stack.

(*c*) *Filter* (fig. 141). The filter consists of a choke, 4-μf capacitor, a 2,000-ohm bleeder resistor, and a 170-μf capacitor. The filter circuit smoothes out irregularities in the pulsating d-c leaving the rectifying elements, thus providing at the d-c output receptacle a direct current suitable for operating the line relay. The filter choke and a 170-μf capacitor are connected in series with the negative lead from the rectifier stack. The choke acts as a high impedance to the flow of pulsating current and as a low resistance to the flow of d-c. The bleeder resistor provides a constant load for the rectifier and thus prevents the output voltage from rising too sharply when the circuit is open. The 170-μf capacitor provides a low impedance path across the output for pulsating current. The 4-μf capacitor in the filter circuit acts as a tuning capacitor, adapting the filter to the frequency of the input power supply.

b. Rectifier Rec–10 (fig. 142).

(1) *Description and purpose.* The Rec–10 rectifier, furnished with older models of Teletypewriters TT–5/FG and TT–6/FG, is designed to provide d-c suitable for signal line and local battery.

(*a*) *Input.* The input requirements are 105- to 125-volt, 50- to 60-cycle, single-phase a-c.



TM2215-137

Figure 141. Rectifier Rec–29, schematic wiring.

(*b*) *Output.* The output rating is 0.2 ampere at 120 volts d-c. (No-load voltage of a new rectifier should not exceed 135 volts.)

(2) *Components.* The rectifier consists essentially of a transformer, a power-stabilizing capacitor, a full-wave selenium rectifying assembly, a chock coil with capacitor, a bleeder resistor, a filter capacitor, terminal panel, output fuse, input cord with plug, and output cord with receptacle.

(*a*) *Transformer.* A 10-μf capacitor is connected across the outside taps of the input windings on the transformer to improve the stability of the rectifier under small variations in power input and load. The secondary of the transformer is provided with taps so that the output voltage of the rectifier can be adjusted to suit requirements and to compensate for the aging of the rectifier assembly. These taps are wired to terminals on the control panel, and connections to the terminals are made by means of flexible leads. The three taps marked L, M, H provide coarse voltage adjustment, and the five taps marked 1, 2, 3, 4, 5 provide fine voltage adjustment. The cover of the rectifier must be removed to reach the control panel.

(*b*) *Cords.* The input cord enters the rectifier through the base and is connected directly to the transformer. No power switch is provided on the Rec–10 rectifier, and rectifying action starts when the a-c input plug is connected to an a-c power source. The output cord connects to terminals on the control panel and exits through the base of the rectifier.

c. OPERATION. The operation of the Rec–10 rectifier and the Rec–29 rectifier are similar, with the following exceptions:

(1) *Primary.* There is no provision on the primary for the furnishing of a-c power for the motor.

(2) *Filter.* The filter circuit consists of a fixed choke, a 2-μf capacitor connected across the choke, a 2,000-ohm bleeder resistor, and a 200-μf capacitor. The fixed choke furnishes no provision for regulating the filter to various frequencies.

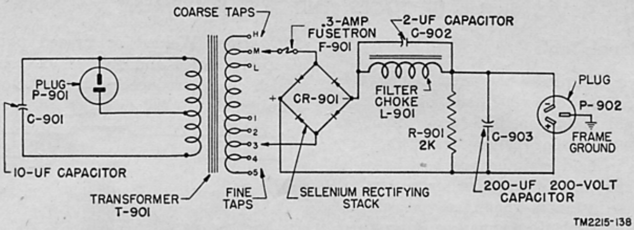
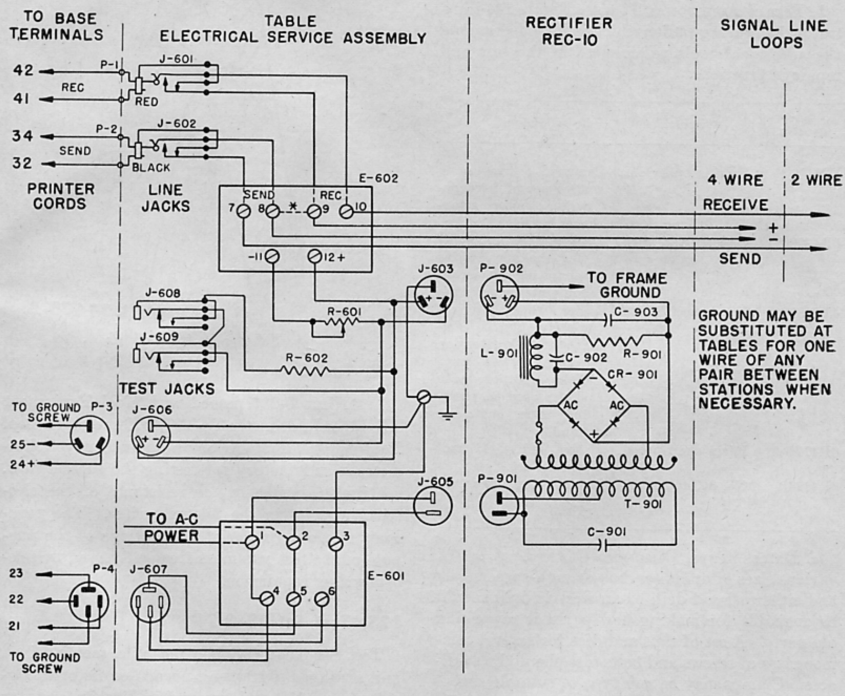


Figure 142. Rectifier Rec-10, schematic wiring.



* IF SENDING AND RECEIVING LOOPS ARE USED, WIRE AS SHOWN WITH STRAP REMOVED FROM TERMINALS 8 AND 9 OF TABLE.

IF SINGLE LOOP IS USED, CONNECT TO TERMINALS 7 AND 10 AND STRAP 8 AND 9.

TM2215-139

Figure 143. Connections between teletypewriter and loop.

121. Additional Tools

a. General. Detailed repair instructions refer to the use of certain tools which are not furnished as part of Tool Equipment TE–50 or TE–50–A. These additional tools, or their equivalent, usually are available in field maintenance kits intended for use where extensive teletypewriter repairs are made. In some instances when these tools are not available, suitable substitutes may be improvised. The additional tools are listed in *b* below.

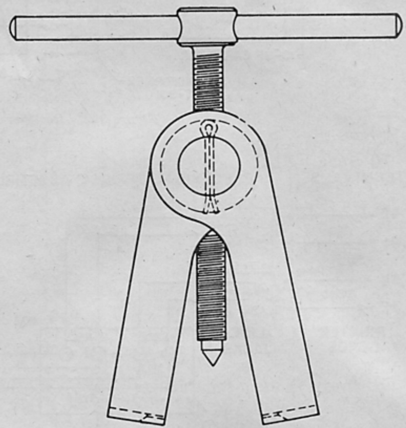
b. List of Additional Tools. Figure 144 illustrates the bearing puller which is included among the additional tools referred to in the test and repair instructions.

Signal Corps stock No.	Name of tool	Description
4T84020	Bearing puller	Designed for removing all types of teletypewriter motor armature bearings.
6R46290	Undercutter, mica	Designed for undercutting the mica strips separating the motor commutator segments
4T74803	Handwheel	Metal wheel approximately 2″ in diameter, with extension which screws onto right end of main shaft; used in rotating main shaft by hand.
6R4774–6	Pliers, short-nosed	Heavy, 6″ lg, 1″ wd; general use.
6R41140	No. 340 tool	Polar relay armature gap adjuster.

c. Drills, Taps, Dies, and Clamps. A set of various sizes of drills (carbon or high-speed steel) and either a hand drill or an electric drill should be available for making new parts or reworking old parts. A set of taps and dies for several common sizes of screws and bolts also should be available. Clamps may be any type of suitable size.

d. Welding and Brazing Equipment. In emergencies, many broken parts may be welded or brazed. However, either procedure is very difficult and should be performed *only* by personnel thoroughly skilled in welding and brazing techniques.

Caution: Welded or brazed parts must be properly alined and free of excessive build-ups which would reduce clearance below minimum requirements.



TL 54475-S

Figure 144. Bearing puller.

122. Test Sets

Test Unit I–236, issued with Tool Equipment TE–50, or Multimeter TS–297/U, issued with Tool Equipment TE–50–A, or an equivalent voltohmmeter is satisfactory for testing the current flow, continuity, insulation, or resistance of the electrical circuits in the teletypewriter. The paragraphs below give brief descriptions of the purpose of the test sets most frequently used by teletypewriter repairmen.

123. Test Set TS–2 TG

Test Set TS–2/TG is a portable, motor-driven unit arranged to transmit normal or distorted signals for testing teletypewriter circuits and for checking the efficiency of star-stop selector units on teletypewriters. It sets up two types of distortion: marking or spacing bias and marking or spacing end distortion. Any one of four test signals, R, Y, SPACE, or a test message, may be

transmitted continuously by the test set. For a detailed description of this test set, refer to TM 11–2208.

124. Distortion Test Set TS–383/GG

Distortion Test Set TS–383/GG (fig. 145) is a motor-driven unit normally used in field repair shops. In addition to the characters and functions transmitted by Test Set TS–2/TG, Distortion Test Set TS–383/GG will transmit the Y, T, O, M, V, and LTRS characters and functions. These transmissions are sent either undistorted or with a controlled degree of distortion up to approximately 100 percent. Distortion Test Set TS–383/GG also receives and analyzes distortion in the transmitting circuit of a teletypewriter. Refer to TM 11–2217 for a complete description of this test set.

125. TEST SET I–193–A

Test Set I–193–A (fig. 146) is a compact, portable unit for testing and adjusting polar relays. Test Set I–193–A provides a source of opens and closures at a frequency of either 10 or 20 cps (cycles per second) for lining up circuits. The test set provides a space for four spare polar relays. Refer to TM 11–2513 for complete instructions for using Test Set I–193–A.

126. Test Set I–181

Test Set I–181 (fig. 147) is a current-flow type relay-adjusting set. The primary purpose of the current-flow test set is to measure and control the amount of current flow through the winding of a relay, drop, or similar electromagnetic apparatus which is being tested or adjusted. Test Set I–181

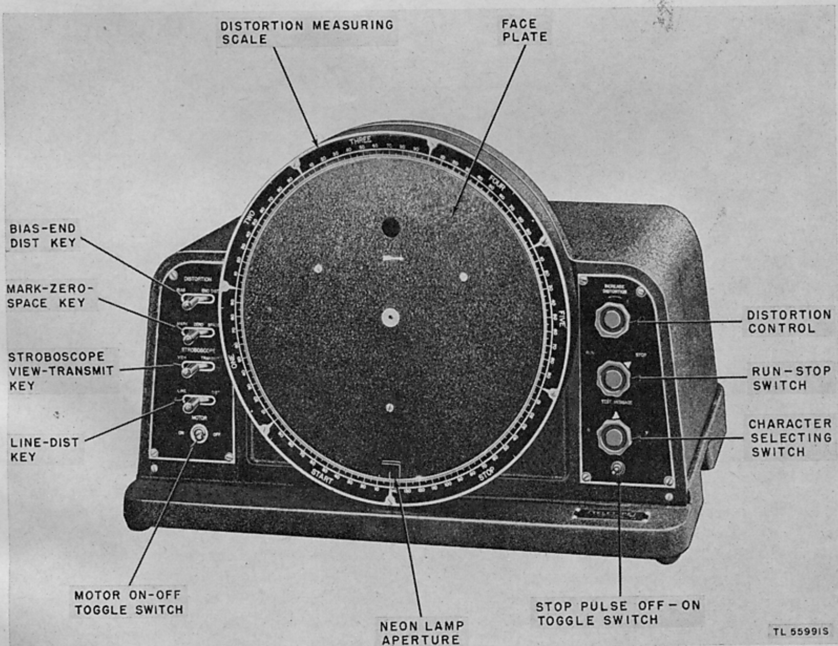


Figure 145. Distortion Test Set TS–383/GG.

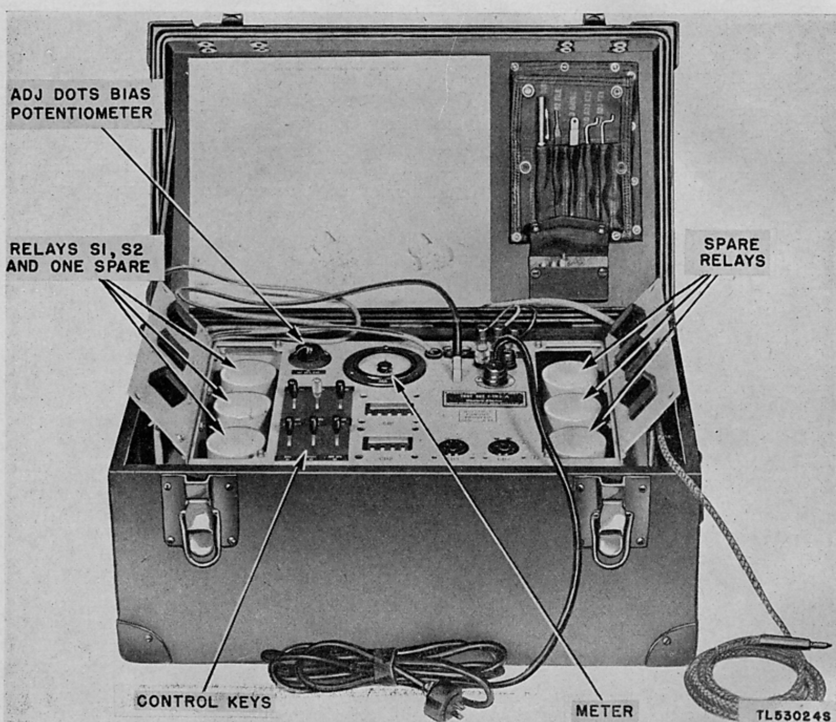


Figure 146. Test Set I–193–A, cover raised.

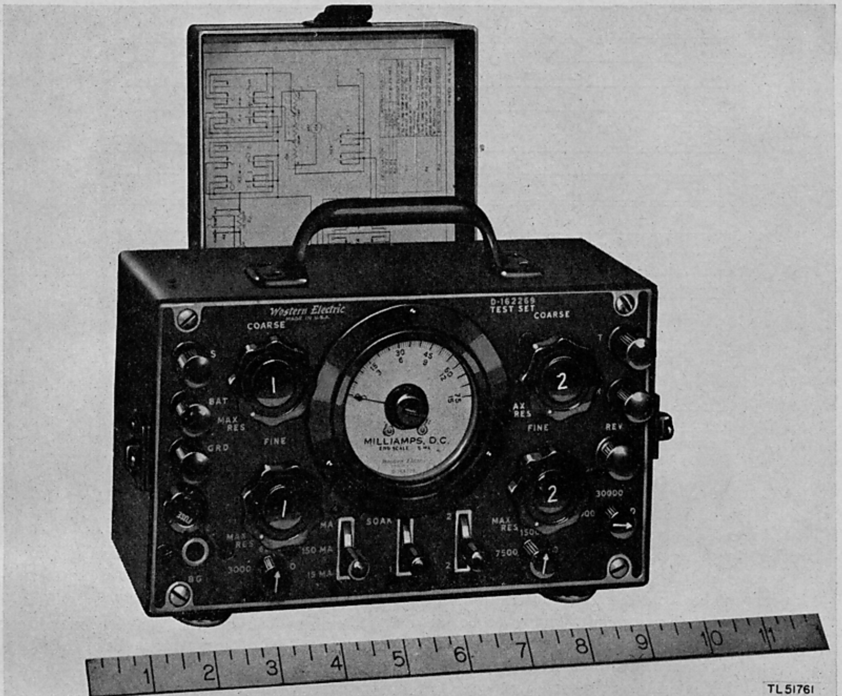


Figure 147. Test Set I–181, cover removed.

also may be used as a d-c milliammeter with ranges of 0 to 15 ma, 0 to 75 ma, and 0 to 150 ma. For a detailed description of Test Set I–181, see TM 11–2036.

Section IV. TROUBLE LOCATION

127. Introduction

a. GENERAL. Several factors must be considered before an attempt is made to actually locate trouble. There can be no definite rules for an exact procedure to be followed because of the wide variations in the experience of personnel working with the equipment. The information and trouble analysis charts in this section are intended to provide a step-by-step procedure for the inexperienced trouble-shooter and a ready reference for the experienced trouble-shooter. In all cases, the origin of the trouble report or the manner in which the trouble is detected will determine the procedure to be followed. Figure 148 shows a typical equipment record card.

b. SOURCE OF TROUBLE REPORTS. Figure 149 is an example of a typical trouble record. Troubles reported may be divided into two classes:

(1) Troubles that are due to failure in the teletypewriter or failure in other equipment or connecting facilities. In some

EQUIPMENT RECORD CARD

Equip and No.	Location	Telephone No.	Date Installed
EE-9 7	BEAVER	BEAVER	5/23/45
Type Circuit	**Remarks**		**Associated Equip**
SIMPLEX	5 MILES FIELD WIRE (ON GROUND) TO REPEATER, CKT 310/10		TG-30
Connected to	**Length of Line**		**Line Crnt. Sply.**
DEXTER	30 MILES		LOCAL

TROUBLE RECORD

Reported				Test Showed	Trouble Found	Cleared		
Date	Hour	By	Trouble			Date	Hour	By
5/24/45	1300	HW	CAN'T SEND	SHORT CKT.	SHORT CKT AT	5/24/45	1320	OC

(over)

TL 57230S

Figure 148. Example of equipment record card.

cases, these troubles may be intermittent and require extensive checks of all equipment and facilities before they can definitely be located. The substitution of teletypewriters or units known to be in good condition is often the fastest method of proving which part of a circuit is causing intermittent trouble.

(2) Troubles which are readily apparent or which are definitely identified by a trouble report as being located in a particular part of the equipment.

c. TROUBLES DETECTED BY INSPECTION. Troubles found during routine check of the equipment, or while inspecting the equipment during a major overhaul, are usually of a definite nature.

TELETYPEWRITER TROUBLE RECORD

TG-7-B MODEL		SERIAL NUMBERS: 85784 BASE	63528 KEYBOARD	101264 MOTOR UNIT; 81754 TYPING UNIT	SET NO. 12		
DATE	TIME	REPORTED BY	TROUBLE REPORTED	DISPOSITION	DATE	TIME	CLEARED BY
17 JAN	0725	W.E.C.	MOTOR FAILS TO START.	REPLACED MOTOR FUSE.	17 JAN	0728	H.M.G.
26 JAN	1945	P.G.C.	PAPER TEARS.	READJUSTED PAPER GUIDE.	26 JAN	2005	W.R.R.
2 FEB	1030	W.E.C.	PRINTS INCORRECT LETTERS AT TIMES.	TIGHTENED SCREW IN RANGE-FINDER ASSEMBLY.	3 FEB	0630	R.F.H.

TL 53943-S

Figure 149. Typical trouble record.

In some cases, however, these troubles may require detailed analysis, using special testing equipment.

d. Trouble Analysis. Thorough knowledge of the sequence of operation for each functioning element in the teletypewriter is of fundamental importance in analyzing trouble. The trouble-shooter must be able to determine quickly whether trouble is in a particular assembly. The appearance of a particular operating failure may indicate immediately the exact location of the faulty adjustment or the damage. If the cause of the failure cannot be determined, it will be necessary to observe carefully which functions are operating properly and which are not.

e. Process of Elimination. By determining which of the transmitting, receiving, and common functions of the teletypewriter are operating properly and which are not operating properly, the trouble-shooter will save considerable time and effort. The trouble analysis charts, which list commonly observed faults, are of great assistance in determining the best sequence and testing procedure for a particular condition. By sending to, and receiving from, a teletypewriter known to be in good condition, the trouble can be proved to be in the transmitting, receiving, or common function. The local or dummy testing circuit in the table can be used when a second teletypewriter is not readily available. When a definite observed fault is found, refer to *g* below for the related list of indicated conditions, and select the items that may logically be the cause of the fault.

f. Localizing Trouble. Determine by observation or testing which of the units or functions are causing trouble; then isolate or localize the trouble in a particular electrical circuit or mechanical element. The trouble analysis charts (pars. 128 through 145) provide reference data for both electrical and mechanical failures.

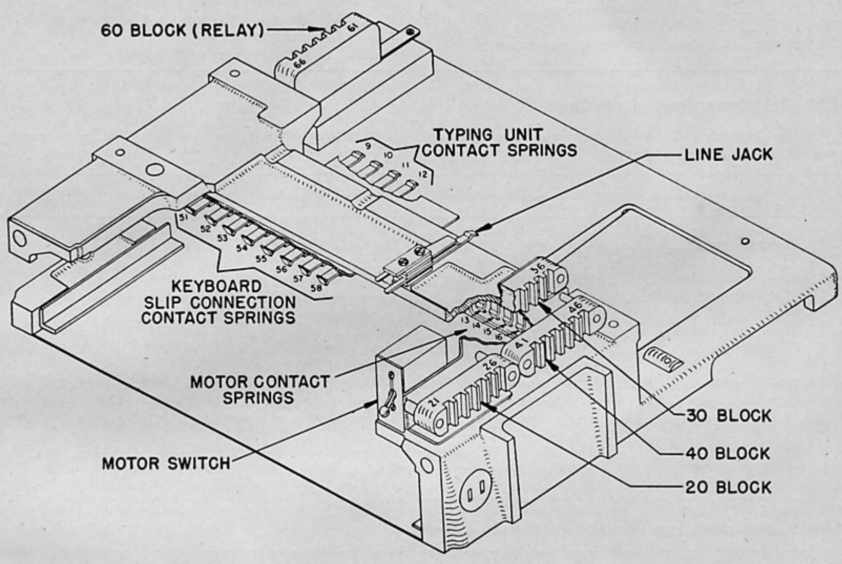


Figure 150. Base terminal boards and contacts.

g. List of Trouble Conditions for Teletypewriters TT–5/FG and TT–6/FG.

(1) *General.*

Par.	Condition	Observed fault
128		Fails to start.
129	Starts	Runs open.
130	Runs closed	Cannot send.
131	Runs closed	Cannot receive.
132	Prints	Rangefinder indicates poor range.
133	Prints	Scrambled letters or occasional errors.
134	Prints	Fails to shift or unshift.
135	Prints	Fails to line-feed properly.
136	Prints	Fails to space properly.
137	Prints	Fails to carriage-return properly.

(2) *Teletypewriter operates correctly with exceptions given below.*

Par.	Observed fault
138	Ribbon remains motionless or does not oscillate.
139	Ribbon does not reverse.
140	Bell does not operate. (Letter S prints correctly.)
141	Letter S does not print. (Signal bell operates with platen in *LTRS* position.)
142	Motor stop fails to operate.
143	More or less than 72 characters per line or margins uneven.
144	Margin bell does not operate on 66th character.
145	Teletypewriter emits grinding noise.

128. Teletypewriter Fails to Start

Note. For this and the following trouble analysis charts (pars. 128 through 145), refer to figure 282 for schematic diagram of the teletypewriters.

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Power source	Open, low voltage, poor voltage regulation.	Use another power source.		
2	Fuse, motor circuit	Fuse, open or missing	Replace with good fuse		
3	Motor-stop contacts	Open or dirty	Clean, check tension and continuity.	Par. 108	Par. 277.
4	Motor-stop mechanism	Contacts do not close	Adjust	Par. 108	Pars. 277, 278.
5	Governor contacts	Open, dirty, or burned away.	Clean or replace and adjust.	Par. 68	Pars. 179, 400.
6	Base contacts	Open contacts between base and typing unit.	Clean and adjust contacts.	Par. 115	Pars. 198, 410.
7	Motor (internal)	Open windings, poor brushes.	Replace brushes or motor		Pars. 170, 408.
8	Main shaft	Clutches dry or bearings frozen tight.	Locate and correct trouble in typing unit.	Par. 69	Pars. 193, 245.

129. Motor Starts but Teletypewriter Runs Opens

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	External circuits:				
	a. Line to outside	*a.* Line open or shorted	*a.* Inform wire chief.		
	b. D-c voltage source	*b.* No voltage, voltage low, or wrong polarity.	*b.* Replace fuse, or reverse polarity.	Pars. 114, 120.	Pars. 200, 428.
	c. Line unit	*c.* Jacks dirty, line fuse blown, or open wiring, switches in wrong position.	*c.* Replace fuse, correct switch positions, or replace unit.	TM 11–359	TM 11–359.
	d. Signal turn-over	*d.* Space received instead of mark.	*d.* Reverse line leads if on polar operation.	TM 11–2005	
2	Wiring	Damaged or excessively oil-soaked.	Repair or replace		Par. 198*c*.

129. Motor Starts but Teletypewriter Runs Opens—Continued

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
3	Selector-magnet circuit	Circuit open or shorted	Check back from receiving plug.	Par. 80.	
4	Keyboard-transmitter circuit.	Circuit open	Check back from black send plug.	Par. 70	Pars. 184, 378.
5	Selector trip-off eccentric screw.	Operates trip latch when armature is in mark position.	Adjust	Par. 80	Par. 282.
6	Main-shaft clutch throw-out lever.	Loose spring	Adjust	Par. 84	Par. 246.
7	Base contacts	Contacts dirty or open	Clean and adjust		Pars. 198, 410.

130. Teletypewriter Runs Closed but Cannot Send

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	SEND REC BREAK key	Key in receive position	Move key to send position	Par. 109	Par. 426.
2	Transmitter contacts and wiring.	Contacts or wiring shorted.	Locate and remove short circuit.	Par. 116	Pars. 382, 383, fig. 283.
3	Transmitter plug	Plug shorted	Remove short, replace plug.	Par. 66	
4	Trip-off pawl eccentric screw (keyboard).	Trip-off pawl does not engage intermediate pawl.	Readjust eccentric screw	Par. 80	Par. 391.
5	Trip-off pawl spring	Spring weak of broken	Readjust or replace spring	Par. 80	Par. 393.

131. Teletypewriter Runs Closed but Cannot Receive

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	External equipment	Improper relay adjustment, improper switch positions.	Refer to the TM on external equipment.		
2	Selector armature spring	Spring loose or broken	Adjust or replace	Par. 80	Par. 209*b*.
3	Selector armature	Armature pivots binding	Loosen and adjust	Par. 80	Par. 263.
4	Selector trip-off eccentric screw.	Does not operate trip-latch plunger.	Adjust	Par. 80	Par. 282.
5	Main-shaft throw-out lever	Not operated by sixth cam of selector cams.	Adjust	Par. 84	Par. 246.
6	Vanes	Vanes stuck in LTRS or FIGS position, bell cranks not on vanes properly.	Adjust clearances	Par. 82	Par. 257.

132. Teletypewriter Prints but Rangefinder Indicates Poor Range

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Motor	Speed incorrect	Adjust with tuning fork	Par. 67	Pars. 170, 208, 399.
2	Motor governor	Governor contracts	Clean or replace	Par. 68	Pars. 178, 179, 400.
3	Line current	Too low or too high	Adjust to 60 ma or use line unit and adjust bias.	TM 11–359	Pars. 113, 115.
4	Selector armature spring	Improper tension	Adjust	Par. 80	Par. 209*b*.
5	Selector armature pivots	Too tight	Adjust	Par. 80	Par. 263.
6	Binding of swords, T levers, vanes, bell cranks, or code bars.	Adjustments too tight, wrong lubricant, or dirt in moving parts.	Clean and adjust	Par. 82	Pars. 257, 262, 350.
7	Bell cranks	Improper adjustment	Readjust	Par. 82	Par. 350.
8	Selector cam sleeve	Worn	Replace	Par. 69	Par. 245.
9	Teletypewriter at other end of circuit.	Teletypewriter slow or fast.	Request check of motor speed.		
10	Line and intermediate or terminal equipment.	Various line or equipment troubles.	Clear own teletypewriter with local test and speed check, then refer to wire chief.	Par. 24.	

133. Teletypewriter Prints but Scrambles Letters or Prints Occasional Errors

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Line current	Too low or too high	Adjust to 60 ma or adjust line relay bias if using receive relay.	TM 11–359	Pars. 114*d*, 115*c*.
2	Rangefinder	Improper setting	Adjust to center of operating limits.	Par. 81	Par. 209.
3	Keyboard sending contacts	Contacts dirty or improperly adjusted.	Clean and adjust		Pars. 188, 382, 383.
4	Motor speed:				
	a. Too high	*a.* Shorted governor contacts, or governor adjustment.	*a.* Adjust speed with tuning fork.	Par. 68	Pars. 208, 400.
	b. Too low	*b.* Governor adjustment, contacts burned. Excessive main-shaft friction clutch drag.	*b.* Adjust speed with tuning fork. Clean or replace, and lubricate main-shaft gears, and clutches.	Par. 69	Pars. 192, 193, 208, 400.
5	See also par. 132, items 1 through 10.				

134. Teletypewriter Prints but Fails to Shift or Unshift

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Figures and letters stop screws.	Improper adjustment	Adjust	Pars. 99, 100.	Pars. 289, 290.
2	Shift detent	Detent spring too strong	Adjust	Pars. 99, 100.	Pars. 298, 299.
3	Function-bail spring	Spring too weak	Adjust tension	Par. 95	Par. 258.
4	Shift link turnbuckle	Turnbuckle loose	Adjust turnbuckle	Par. 99	Par. 296c.
5	Letters and figures function levers.	Improper spring tension or spring broken.	Adjust or replace		Par. 291.
6	Function-bail blade	Blade worn, chipped, or out of adjustment.	Replace or adjust	Par. 95	Par. 294.

135. Teletypewriter Prints, but Fails to Line-Feed Properly

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Single-double line-feed detent.	Wrong adjustment	Adjust	Par. 105	Par. 303.
2	Line-feed function lever spring.	Spring broken or missing	Replace		Par. 291.
3	Line-feed link turnbuckle	Adjustment	Adjust	Par .104	Par. 306c.
4	Line-feed detent spring	Missing or broken	Replace	Par. 104	Par. 308.
5	Line-feed detent	Adjustment	Adjust		Par. 305.
6	Pressure roller release cam	Wrong position or wrong adjustment.	Adjust		Par. 315.
7	Pressure roller springs	Missing or broken	Replace		Par. 316.
8	Line-feed check screw	Adjustment	Adjust	Par. 104	Par. 310.
9	Line-feed check lever	Adjustment	Adjust	Par. 104	Par. 312.
10	Line-feed check lever spring	Missing or broken	Replace		Par. 313.
11	Line-feed pawl spring	Missing or broken	Replace		Par. 309.
12	Function-bail blade	Blade chipped, worn, or adjustment.	Replace or adjust	Par. 95	Par. 294.

136. Teletypewriter Prints but Fails to Space Properly

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Space function-lever spring	Broken or missing	Replace		Par. 292.
2	Spacing-escapement pawl operating arm.	Arm bent or screw missing.	Replace and adjust	Par. 88	Par. 325.
3	Spacing rack	Teeth missing or rack broken.	Replace	Par. 88	Par. 351
4	Right margin adjusting screw.	Improper adjustment	Adjust	Par. 88*b*	Par. 370.
5	Carriage guide screws	Screws binding	Adjust		Par. 349.
6	Carriage support rollers	Rollers bind	Adjust or replace		Par. 242.
7	Spacing stop-lever bracket	Adjustment	Adjust	Par. 88	Par. 347.
8	Carriage-return lock-bar latch.	Adjustment	Adjust	Par. 98	Par. 337
9	Left margin adjusting screw	Screw out of adjustment	Adjust	Par. 98	Par. 369.
10	Spacing stop-lever spring	Broken or missing	Adjust		Par. 348.

137. Teletypewriter Prints but Fails to Carriage-Return Properly

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Carriage-return spring drum.	Weak tension, unhooked, or broken.	Tighten, engage, or replace.	Par. 98	Par. 354.
2	Carriage-return draw-strap.	Unhooked or broken	Adjust or replace	Par. 98.	
3	Carriage guide-screw	Binding	Adjust		Par. 349.
4	Carriage-support roller bearings.	Rollers binding	Lubricate, adjust, or replace.		Par. 242.
5	Carriage-return function-lever spring.	Missing or broken	Replace		Par. 343.
6	Carriage-return reset bar spring.	Missing or broken	Replace		Par. 342.
7	Carriage-return operating-lever spring.	Missing, broken, or weak	Replace		Par. 344.
8	Carriage-return latch-bar latch.	Bent or rounded edge, adjustment.	Repair or replace, adjust	Par. 98	Par. 337.
9	Reset bar	Missing or broken	Replace		Par. 337.
10	Carriage-return operating-lever stop.	Stop does not allow lever to disengage clutch.	Adjust	Par. 98	Par. 341.
11	Spacing-shaft lower bearing bracket adjustment.	Improper clearance between gears.	Adjust		Par. 249.
12	Spacing-rack adjustment	Rack binding	Adjust		Par. 351.
13	Function-bail blade	Chipped, worn, or adjustment.	Adjust or replace	Par. 95	Par. 294.

138. Teletypewriter Prints but Ribbon Remains Motionless or Does Not Oscillate

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Ribbon spool-shaft and feed-shaft spur gears and vertical and horizontal feed-shaft bevel gears.	Gear setscrews loose or missing, spur gears do not mesh.	Adjust, tighten, and replace missing parts.	Par. 90	Pars. 218, 221.
2	Vertical feed-shaft collar	Collar loose	Adjust collar for correct spring compression.	Par. 90	Par. 223.
3	Horizontal feed-shaft detent spring.	Missing or improper adjustment.	Replace, adjust	Par. 90	Par. 217.
4	Ribbon	No slug near end to operate ribbon-reverse arm.	Replace ribbon.		
5	Ribbon-reverse shaft link adjustment.	Improper link position	Adjust	Par. 91	Par. 226.
6	Ribbon feed-pawl spring	Loose or missing	Replace		Par. 214.
7	Ribbon oscillator-lever spring.	Spring loose or broken	Replace	Par. 92	Par. 234.
8	Ribbon oscillator-lever	Broken or caught in slot	Replace and adjust	Par. 92	Par. 371.
9	Ribbon lock-out bar	In locked-out position	Change position	Par. 112	Par. 372.
10	Ribbon spool	Not seated on spool shaft and pin.	Adjust		Par. 14*a*.

139. Teletypewriter Prints but Ribbon Does Not Reverse

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Ribbon reversing eyelets	Missing or too near ribbon end.	Replace ribbon		Par. 14.
2	Ribbon feed-shaft detent spring.	Spring adjustment	Adjust		Par. 217.
3	Vertical ribbon-feed shaft collar.	Collar loose	Adjust and tighten	Par. 90	Par. 223.
4	Ribbon-reverse shaft link	Improper angular adjustment.	Adjust and tighten	Par. 91	Par. 226.
5	Ribbon-reverse pawl springs.	Missing or broken	Replace and check tension.	Par. 91	Par. 230.

140. Teletypewriter Prints, but Signal Bell Does Not Operate (Letter S Prints Correctly)

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Bell function-lever spring	Missing or broken	Replace		Par. 335.
2	Sixth vane	Vane binds or connecting links missing or broken.	Adjust or replace defective parts.	Par. 101	Par. 256.
3	Function-bail blade	Missing, chipped, worn, or adjustment.	Replace or adjust	Par. 95	Par. 294.
4	Bell-hammer arm	Arm binds at pivots	Adjust pivots	Par. 107.	
5	Bell operating-lever spring	Missing or broken	Replace	Par. 107	Par. 333.
6	Bell reset-bar spring	Missing or broken	Replace	Par. 107	Par. 334.
7	Bell-hammer backstop	Adjustment	Adjust	Par. 107	Par. 332.
8	Signal bell latch-bar latch	Bar worn, or latch adjustment	Replace, adjust	Par. 107	Par. 331.

141. Teletypewriter Prints, Letter S Does Not Print, Signal Bell Operates When Platen Is in Letters Position

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Sixth vane	Vane is binding, vane extension out of adjustment or broken.	Adjust	Par. 101	Pars. 255, 256.
2	Signal bell function lever	Broken or chipped at sixth vane.	Replace	Par. 107.	
3	Bell latch-bar latch	Missing, bent, or broken	Replace	Par. 107	Par. 331.
4	Bell latch bar	Defective	Replace	Par. 107.	

142. Teletypewriter Prints, Motor Stop Fails to Operate

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Sixth vane	Binds or does not operate.	Adjust	Par. 101	Par. 256.
2	Motor-stop lever bracket	Bracket loose	Adjust	Par. 108	Par. 270.
3	Motor-stop pawl spring	Missing or broken	Replace	Par. 108	Par. 275.
4	Motor-stop pawl backstop	Adjustment	Adjust	Par. 108	Par. 273.
5	Motor-stop pawl backstop screw.	Binds stop pawls	Adjust	Par. 108	Par. 272.
6	Motor-stop lever eccentric	Adjustment	Adjust	Par. 108	Par. 271.
7	Motor-stop release lever eccentric.	Eccentric adjustment	Adjust	Par. 108	Par. 274.
8	Contact spring	Incorrection tension or contact clearance.	Adjust contact clearance or tension.		Pars. 361, 362.
9	Motor-stop contacts	Contacts fused, shorted internally, or effectively shorted by wiring.	Open motor-stop contacts, locate and clear shorts.	Par. 108	Pars. 361, 362.
10	Motor-stop function lever spring.	Tension adjustment, spring missing or broken.	Adjust or replace	Par. 108	Par. 278.
11	Heavy motor-stop contact springs.	Adjustment	Bend to proper clearance.		Pars. 361, 362.

143. Teletypewriter Prints More or Less Than 72 Characters Per Line or Left Margin Is Uneven

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Left margin adjusting screw	Screw loose or missing	Tighten or replace. Adjust in or out until left margin is even.	Pars. 7, 27*b*	Par. 369.
2	Right margin adjusting screw.	Adjustment or wrong position.	Adjust for 72 characters per line; adjust for even right margin.	Pars. 7, 27*b*	Par. 370.
3	Right margin detent spring	Loose or missing	Replace	Pars. 7, 27*b*	Par. 241.
4	Carriage-return spring	Incorrect spring tension	Adjust	Par. 98	Par. 354.
5	Dash pot	Vent screw adjustment, piston binding.	Adjust, lubricate	Par. 98	Par. 377.
6	Spacing stop lever	Binds	Lubricate, adjust	Pars. 88, 102.	Par. 347.

144. Teletypewriter Prints, but Margin Bell Fails to Operate on 66th Character

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Bell-hammer spring	Missing or broken	Replace	Par. 89	Par. 328.
2	Margin-bell cam	Adjustment	Adjust	Par. 89	Par. 374.
3	Margin-bell pawl spring	Missing or broken	Replace	Par. 89	Par. 236.
4	Margin-bell pawl	Binding or missing	Adjust or replace	Par. 89.	
5	Bell-hammer arm shaft	Binding	Adjust	Par. 89.	

145. Teletypewriter Prints, but Emits Grinding Noise

Item No.	Items to be checked	Possible trouble	Corrective action	Detailed function	Repair and adjustment data
1	Typing unit mounting screws.	Screws loose	Tighten	Par. 13e(9).	
2	Main-shaft bearings	Bearings broken or burned	Replace and lubricate		Pars. 192, 193.
3	Motor-mount adjusting screws.	Improper drive gear clearance.	Adjust		Par. 365.
4	Transmitting shaft	Fiber gear worn or bearings worn.	Replace worn parts	Par. 70	Par. 210.
5	Transmitter clutch throw-out lever.	Clutch clearance	Adjust	Pars. 70, 71	Par. 385.
6	Main-shaft clutch throw-out lever.	Improper clutch clearance.	Adjust	Par. 84	Par. 246.

146. Localization of Electrical Troubles

a. General. Electrical circuits in the teletypewriter are provided with connecting terminals at points where it is necessary to connect or disconnect circuits or units. Do not disturb the wiring any more than is necessary during testing and inspection. The majority of electrical troubles will be found at contacts in switches and jacks or where the insulation on wires or between metal parts has been damaged. The repairman must be familiar with the use of schematic and wiring diagrams and must use them while making point-to-point checks of the teletypewriter circuits until the fault has been located. Schematic wiring diagrams of external equipment to which the teletypewriter is connected will furnish information, which will help the repairman in setting up circuits for testing and localizing teletypewriter trouble. Detailed procedure for localizing electrical trouble is furnished in paragraph 148 for the power and signal circuits. Figure 151 shows connections to the table.

b. Testing Procedure. Actual procedures for locating electrical troubles will vary, depending upon whether the work is being done by organizational repair personnel using Test Unit I–236 (part of Tool Equipment TE–50) or Multimeter TS–297/U (part of Tool Equipment TE–50–A). Basic principles remain the same for any given trouble, but certain troubles, such as part of a shorted-out resistor or small variations in voltage, cannot be measured accurately with Test Unit I–236. All of the more common troubles, however, can be located with this test unit and the data in pargraphs 147 through 149 are arranged to start with the use of Test Unit I–236 or Multimeter TS–297/U; the data also gives additional information for use of field repair personnel responsible for major overhauls of the equipment.

c. Testing Capacitors. Three possible trouble conditions that may occur in capacitors are: opens, shorts, and leakage. Leakage is a flow of current through a capacitor that is partially shorted. Test Unit I–236 or Multimeter TS–297/U can be used for testing capacitors. Two other methods for testing capacitors are the spark test described in (1), (2), and (3) below and the ohmmeter test described in (4) below.

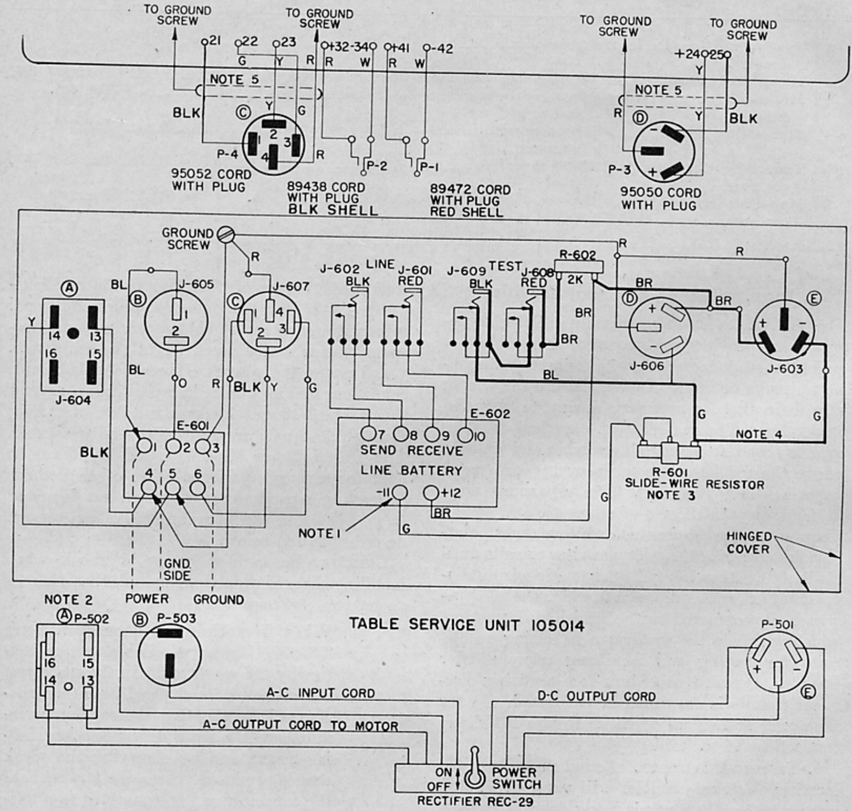
Caution: Be careful to avoid shock when handling charged capacitors or leads that are connected to a power source.

(1) When Test Unit I–236 or Multimeter TS–297/U is not available, test capacitors by the spark test. In the spark test the capacitor is charged and then discharged by shorting the capacitor terminals with a screw driver or other similar means and by observing the spark that is produced. Also, the terminals of the capacitor can be connected to a telephone headset or test receiver to listen for a click. Instructions for making the spark test are given in (2) and (3) below.

(2) To test a capacitor of 0.1 μf or higher value, proceed as follows:

(*a*) Disconnect the capacitor from the circuit in which it is used.

(*b*) Connect the capacitor by means of suitable leads to a source of 90 (or more) volts d-c.



NOTES:

1. LOOP BATTERY MAY BE SUPPLIED FROM TERMINALS 11 AND 12 IF REQUIRED.
2. CONNECTOR PLUGS AND TABLE SERVICE ASSEMBLY RECEPTACLES TO WHICH THEY CONNECT ARE DESIGNATED BY ENCIRCLED LETTERS.
3. ZERO TO 2500 OHM SLIDE-WIRE RESISTOR ADJUSTED TO 1700 OHMS AT FACTORY.
4. HEAVY LINE INDICATES LOCAL TEST CIRCUIT.
5. (====) INDICATES SHIELDED CABLE.

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Figure 151. Table connections, wiring diagram.

(c) Disconnect one of the leads, after a few moments.

(d) After approximately 1 to 2 minutes, short the capacitor terminals with a screw driver. If a capacitor is in good condition a spark will jump between the screw driver and one of the terminals. An open capacitor or one that is shorted will give off no spark.

Note. For this test, disconnect the capacitor from the rest of the circuit in which it is used. An associated resistor or other device can serve as a path by which the charge in the capacitor may leak away. Therefore, to subject it to the spark test, it is always best to remove the capacitor from the circuit.

(3) For capacitors of a value less than 0.1 μf disconnect the capacitor from the circuit in which it is used ((a) above). Charge it in the same way as the capacitor of larger value. Wait ½ minute, and then connect the tips of a telephone headset or a test receiver across the capacitor terminals. A click will be heard in the receiver if the capacitor is in good condition. No click will be heard if the capacitor is open or shorted.

(4) The ohmmeter method may generally be used when the capacitor to be tested is of a value of 0.01 μf or greater. When a good capacitor of sufficient size is connected to an ohmmeter, the meter needle will *kick* up-scale and then show an open circuit. If the needle does not kick, the capacitor is shorted. A shorted capacitor gives a steady meter reading, depending upon the resistance of the short.

d. Testing Resistors, Checking Circuit Continuity. Use Test Unit I–236, Multimeter TS–297/U, or any ohmmeter to test resistors or to check circuit continuity. *Before measuring resistance or making continuity tests with any instrument that furnishes its own testing battery, disconnect the teletypewriter completely from all external power and signal circuits, because false measurements may result, and there is danger of damaging the measuring instrument.* In most cases, resistors may be measured and circuit continuity checked without disconnecting any of the circuit elements. However, parts of the circuits that are connected in parallel must be isloated before accurate tests or checks are made. Connect individual circuits to the proper power supply for making point-to-point voltage and current checks. *Do not attempt to measure resistance with an ohmmeter while current from the rectifier is flowing in the circuits.*

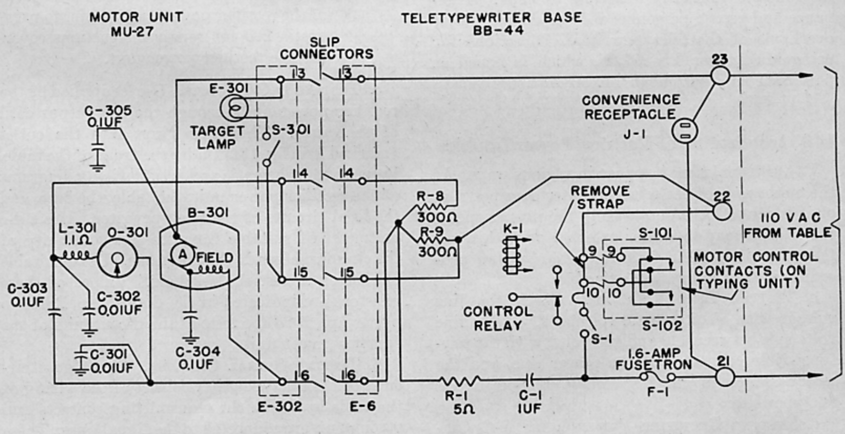


Figure 152. Mu–27 teletypewriter motor circuit connections.

e. CIRCUIT FOR TESTING. Localizing electrical troubles in the signal circuit requires a means of providing a normal 60-ma current in a closed circuit (consisting of the send and receive circuits connected in series). When a test is made using this arrangement, it is referred to as operating in a local or dummy circuit, to distinguish it from a regular connection with a second teletypewriter. The table, which is part of Teletypewriters TT–5/FG and TT–6/FG, contains a local test circuit in which the operating components may be connected. This circuit is set up (fig. 151) by pulling the red- and black-shelled teletypewriter plugs from the line jacks and inserting them into their respective test jacks. After a major overhaul, inspections can be made by using this test circuit at the table. A second teletypewriter can be connected by means of the test jacks to serve as a standard for comparison (using the send plug of one teletypewriter and receive plug of the other).

147. Use of Test Unit I–236 or Multimeter TS–297/U for Localizing Electrical Troubles

TM 11–2056 describes the manner in which Test Unit I–236 may be used to test continuity and voltages in place of more delicately constructed instruments, normally available to field maintenance and repair personnel for use during major overhauls of the teletypewriter. Directions for using Multimeter TS–297/U, which is issued as part of Tool Equipment TE–50–A, are given in TM 11–5500.

148. Localization of Electrical Power Troubles

Power troubles may appear in various ways. If the motor unit of the teletypewriter does not run, or if it cannot be brought up to the proper speed, the trouble may be either external or within the teletypewriter. The following step-by-step procedure is used to locate the trouble.

a. TESTING LINE VOLTAGES. Check the line voltage with a suitable a-c voltmeter. If the line voltage is between 110 and 125 volts, with the teletypewriter connected to the power line, and the motor switch is on, the trouble is within the teletypewriter.

b. TESTING RECTIFIER POWER UNIT A-C CIRCUIT. Figure 151 shows the actual wiring of the table and serves also as a schematic diagram.

(1) Test the a-c input circuit of the table.
(2) Test the a-c input cord by which power is delivered to the rectifier power unit.
(3) Test the output cord that connects to plug AE (fig. 151).
(4) Test the a-c circuit from plug A to the terminals on the power block at the right-hand front corner of the base (by which power is connected to the motor unit). (These are terminal Nos. 21 and 23 on the 20 block.)
(5) Refer to figure 151 and test the a-c circuit to the motor unit. If the circuit tests in (1) through (4) above show that there is no interruption of continuity and that the desired voltage is available at the motor unit, it will be necessary to test the motor unit. Refer to paragraph 167 for information relative to test and repair of motor units. If the voltage being delivered to the rectifier power unit is of the proper value, but the a-c output to plug A (fig. 151) is either too low or not available, check the connections of the a-c output cord at the cord panel of the rectifier power unit (fig. 153). If the a-c input is of the proper value but the a-c voltage output is too low or not available, check the connections at the tap and fuse panel of the rectifier power unit. Refer to paragraph 200 for repair instructions covering the rectifier power unit.

c. TESTING D-C CIRCUITS. D-c is supplied by the rectifier power unit through the d-c output cord of that unit. This cord plugs into the outlet (marked E in fig. 151) under the front of the table. Refer to the schematic and actual wiring diagrams of the rectifier power unit, the table, the base, and the local circuits of the teletypewriter. Use a d-c voltmeter of suitable range to test continuity of the circuits shown in the diagrams. Use a suitable ohmmeter to test the resistors. Values of these resistors are indicated in the diagrams. Refer to paragraph 200*d* for tests of the d-c circuits of the rectifier power unit.

d. TESTING SIGNAL CIRCUITS. The signal circuits of the teletypewriter consist of the wiring of the table by which the transmitting contacts and typing unit are connected to the signal lines. These circuits terminate at line and battery terminal boards and include the wiring to the jack blocks.

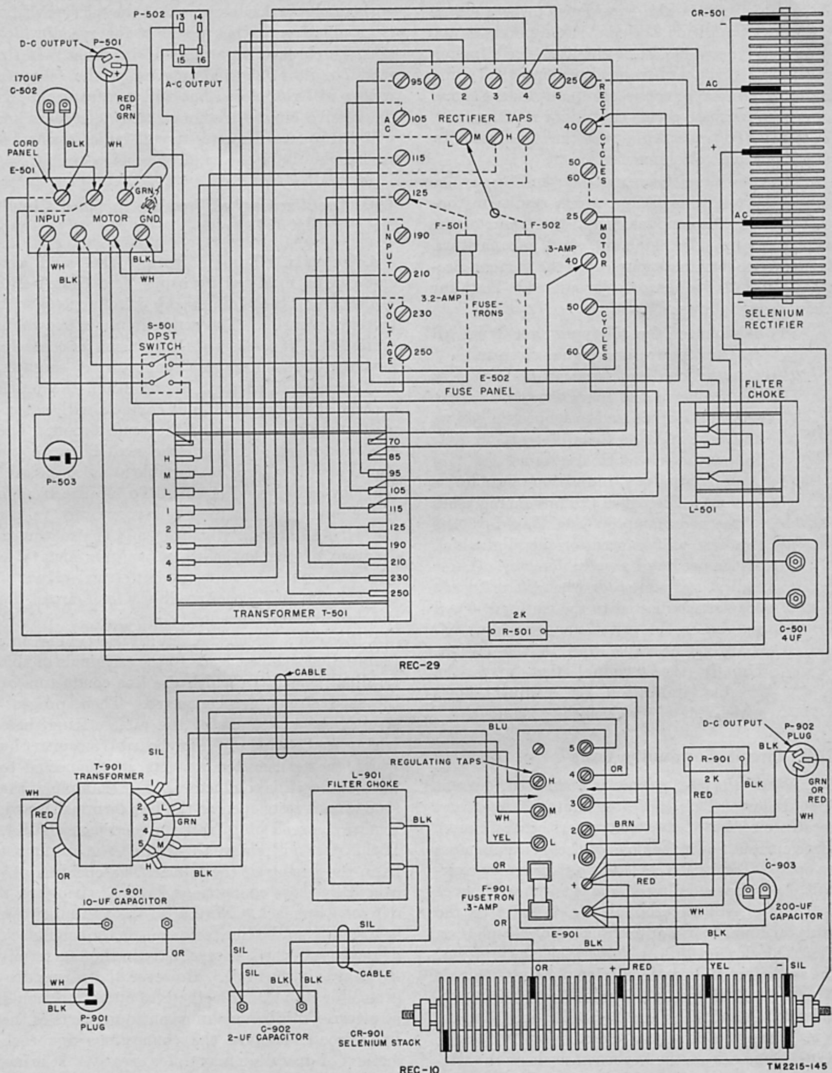


Figure 153. Rec–10 and Rec–29, actual wiring.

The test circuit is also considered to be a signal circuit. In addition, the connection points on the send and receive blocks of the base, the slip contacts of the keyboard-transmitter, and the typing unit are terminal or connection points in the signal circuits. At these points continuity readings may be taken. To test continuity of the signal circuits, use a suitable voltohmmeter.

e. LOCATION OF GROUNDS. Grounds may be caused by worn insulation, which results in contact between the conductors and the frame of the teletypewriter. In addition, faulty capacitors, resistors, or terminals may cause the various electrical circuits to become grounded. Test for grounds as follows:

(1) Disconnect the teletypewriter from all external power and signal circuits.
(2) Connect one lead from an ohmmeter to the frame of the teletypewriter.
(3) Touch the other lead to connection points and terminals of the different circuits; follow the schematic diagrams.
(4) Any continuous indication signifies a ground. Disregard the few short flashes of the neon lamp on Test Unit I–236, if this test unit is used, or the slight kick of the needle of a voltohmmeter. These indications will occur when the test leads are first connected to the equipment and are due to the initial charging and discharging of capacitors in the circuit. Usually the terminal that gives the greatest indication, or reading, shows which side of the circuit is grounded.

149. Circuit Continuity Tests

a. When the test circuit is connected, current should flow. This indicates that the send and receive circuits of the teletypewriter are closed. If no current flows, then one of these circuits must be open. To test the continuity of the receive circuit, short the send plug or connect a jumper across the send circuit at terminals No. 7 and 8 on the table terminal board, or terminals No. 32 and 34 on the 30 block (fig. 151). To test the continuity of the send circuit, short the receive plug or terminals No. 9 and 10 on the line terminal board or terminals No. 41 and 42 of the 40 block (fig. 151).

b. When the circuit is closed, sent RY's and test sentences from the keyboard to check the teletypewriter as a unit. If the machine operates without error, then assume that the teletypewriter is trouble-free except possibly for speed which must be checked separately if in doubt. If the send circuit is shorted internally, the teletypewriter will run closed but will not transmit. If the receive circuit is shorted, the teletypewriter will run open. These tests will indicate whether the trouble is in the send or receive circuit.

150. Localization of Trouble in Send Circuit (fig. 154)

a. GENERAL. Trouble within the send circuit can be localized by using Test Unit I–236, Multimeter TS–297/U, or any voltohmmeter with battery in series. The send circuit is shown in figure 154. It consists of the transmitter contacts, keyboard-transmitter slip connectors or contacts, and associated wiring. In addition, the break contact and keyboard shunt contacts with associated wiring are parts of the send circuit. The cord and wiring through the send block to the signal circuit wiring of the table are also integral portions of the send circuit. To localize trouble in the send circuit of these teletypewriters, follow the wiring diagram (fig. 154) and the schematic diagram of the keyboard-transmitter and table (fig. 282). The locations and electrical values of the resistors and capacitors in the send circuit are shown in these diagrams.

b. LOCATION OF OPENS. With the typing unit removed, attach test leads to the terminals of line terminal boards, to which the line conductors of the send circuit are connected. Then, progressively, test continuity of the table wiring, base wiring, and wiring of the keyboard-transmitter by which the transmitter contacts are connected to the outgoing line conductors. For example, if the send circuit tests open at the line terminal board, remove the send plug from the send jack (BLK). If this does not remove the trouble, the open must be in the wiring of the table. The open may be caused by loose connections, broken wiring, or a defective line jack. Normally, line continuity can be tested from the line terminals on the send block of the base to the line terminals on the line terminal boards in the table. However, the wiring diagrams for the various methods of operation should be referred to when making continuity tests of the line circuit, because the connections for each method of operation may differ greatly. It is important to observe whether the teletypewriter is

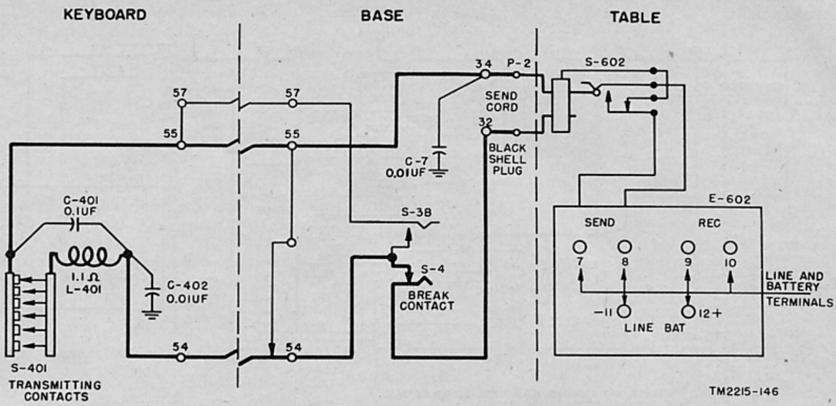


Figure 154. Teletypewriter send circuit connections.

supplying line current. If it is, the two line resistors (fig. 151) which are installed in the electrical service assembly of the table are in series with the line and will have to be considered. These resistors are 2,000 and 2,500 ohms. The 2,500-ohm resistor may be adjusted so that the teletypewriter supplies line current of 60 ma. Therefore, if the reading on an ohmmeter used to test continuity indicates a relatively high resistance, check to see that the teletypewriter is connected so as to supply line current. Also, if there is an indication of an open circuit that cannot be located readily, check the connections of the line resistors.

c. Location of Shorts. Shorts in the send circuit may be located in much the same manner as described above for location of opens. The main difference is that in locating an open, continuity is tested between both ends of each conductor of a circuit. In locating a short, a reading is taken across both conductors of the circuit. The line terminal boards of the table and base provide convenient test points. In testing for short circuits, as well as for opens, in the send circuit, refer to the appropriate diagram showing the wiring arrangement for the method of operation.

151. Localization of Trouble in Receive Circuit (fig. 155)

a. General. Continuity tests to locate trouble in the receive circuit are similar to those used for locating trouble in a send circuit. The wiring diagrams for the various methods of operation will show the circuits at the table that are used for sending, those that are used for receiving, and those that are common to both functions. In addition, the circuits involving the transmitter jacks may also be part of the receive circuit, or in some cases they may be connected to independent lines. Refer to the appropriate wiring diagrams when testing these circuits.

b. Locating Opens. The receive circuit includes the wiring of the table to the receive block on the base through the receive jack in the jack block (RED). Included in the receive circuit are the line relay and the selector magnet. The relay as used here prevents direct electrical connection between line and selector magnets. The resistances of the windings of these elements of the circuit are given in figure 155. Continuity tests of the receive circuit may be conducted in a manner similar to that used to locate opens in the send circuits (par. 150). Make tests from each convenient terminal or connection point of the table, the base, and the typing unit.

c. Locating Shorts. Shorts may be located by conducting tests as outlined in paragraph 150*c*. Resistance readings that are relatively high may be due to the resistance of the magnet coils or the windings of the relay. Also, refer to the wiring diagrams to determine the values of the resistors

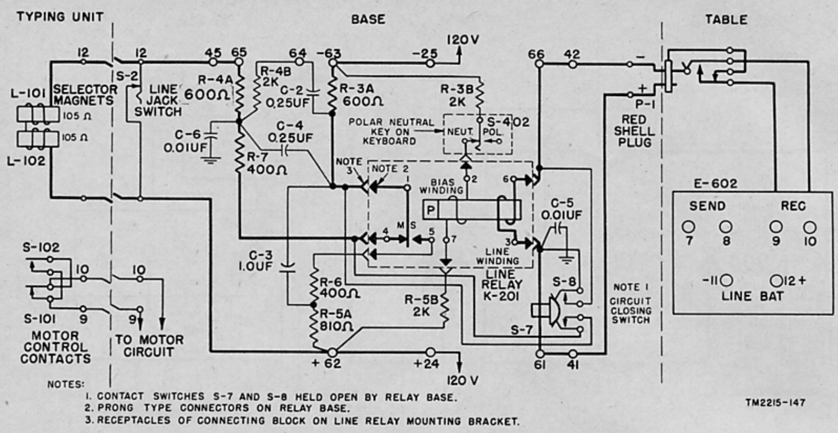


Figure 155. Teletypewriter receive circuit connections.

in the receive circuit and the circuits through the relay contacts that should be normally closed and those that should be normally open.

152. Introduction to Localization of Mechanical Troubles

a. When a mechanical function fails to operate, or operates in a faulty manner, it is necessary to isolate the trouble. The trouble may be in a particular adjustment or series of adjustments, or it may be in a particular assembly. The experience of the repairman and the over-all condition of the equipment will indicate which of the two methods below is the better approach to localizing various types of troubles.

(1) One method involves checking the individual requirements for all adjustments in the assembly or mechanism. Use the data found in the detailed adjustment requirements (sec. VII of this chapter) to determine the sequence to be followed.

(2) The other method involves setting up the vanes or selecting mechanism by hand and completing the operation by manually rotating the motor, shaft, gear, or cam that normally drives the assembly. This method is quicker when only one adjustment is out of order and the remainder of the mechanism seems to be in good condition. In such instances, only the related adjustment needs to be checked. However, in some cases faulty operation may be observed only when the mechanism is power-driven.

b. Additional aid in locating mechanical troubles may be obtained from records of previous troubles and adjustments.

c. The procedure for localizing mechanical troubles may be divided into the effects of the trouble observed, as follows:

(1) Teletypewriter does not start (par. 153).
(2) Typing unit runs open (par. 154).
(3) Keyboard-transmitter runs open (par. 155).
(4) Teletypewriter scrambles letters and functions (par. 156).
(5) Certain functions do not operate correctly (par. 158).

153. Locating Trouble When Teletypewriter Fails To Start

a. Electrical Trouble. Refer to paragraph 146 for electrical power troubles and figure 152 for motor-circuit connections. Electrical trouble in the motor circuit may be due to mechanical ad-

justment of contacts, and the tests for electrical trouble should locate these troubles.

(1) The motor-stop contacts are connected through contact Nos. 9 and 10 of the typing unit slip contacts. The resistance between these two contacts should measure about 1 ohm or less. Short these contacts. If the motor runs, the trouble is in the contact adjustment between the typing unit and the base.

(2) If there is voltage between terminal Nos. 13 and 15 of the motor, short the governor brush springs. If the motor speeds up, check the brush spring tension. The trouble may be due to dirty or burned governor contacts or a broken governor spring.

b. Excessive Motor or Main-Shaft Torque. Turn the motor by hand. If it cannot be turned easily, make the following tests to locate the cause of binding.

c. Binding at Main-Shaft Drive Gear. Remove the screws that hold the typing unit to the base. Try to turn the motor by hand. If the motor now turns easily, the motor pinion was binding on the main-shaft gear.

d. Motor Bearings Bind. With the typing unit removed from the base, turn the motor by hand. If it does not turn easily, the motor bearings are probably burned.

e. Main Shaft Binds. With the typing unit removed, try to turn the main shaft (fig. 156) by hand. If it will not turn, or if great effort is required to turn it, proceed as follows:

(1) Hold the selector magnet armature to the mark position (fig. 157). Turn the shaft, if possible, until the selector cam sleeve and the printing- and function-bail cams do not turn when the shaft is turned. If the main shaft still binds, the trouble is within the main-shaft assembly.

(2) Remove the main shaft and check the main-shaft bearings and the various friction clutches for excessive binding or friction.

f. Transmitter Shaft Binds.

(1) Check gear clearance of transmitter-shaft drive gear when the typing unit and keyboard-transmitter are both secured to the base.

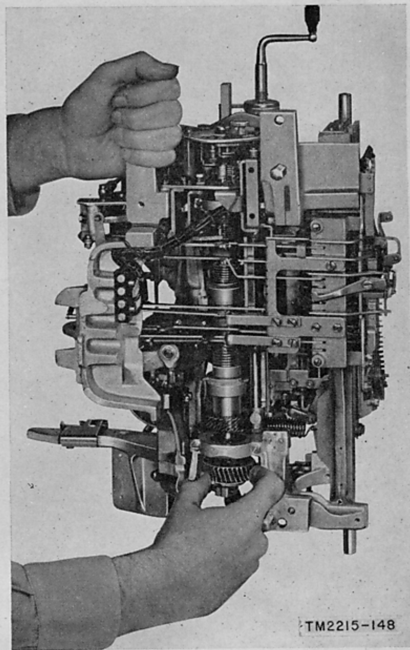


Figure 156. Turning main shaft by hand.

(2) Rotate the shaft by hand with either keyboard or typing unit removed to check the binding of the transmitter-shaft bearings.

154. Locating Trouble When Typing Unit Runs Open

a. Electrical Trouble. Press the selector armature to the mark position. If the armature does not bind and the teletypewriter runs closed, assume that the trouble is electrical. If, however, the teletypewriter does not run closed with the armature in the mark position, the trouble is mechanical and within the typing unit.

b. Selector Trip-Off Mechanism.

(1) Examine the selector-cam sleeve when the selector magnet is in the marking position. If the sleeve rotates, the trouble is in the selector trip-off mechanism.

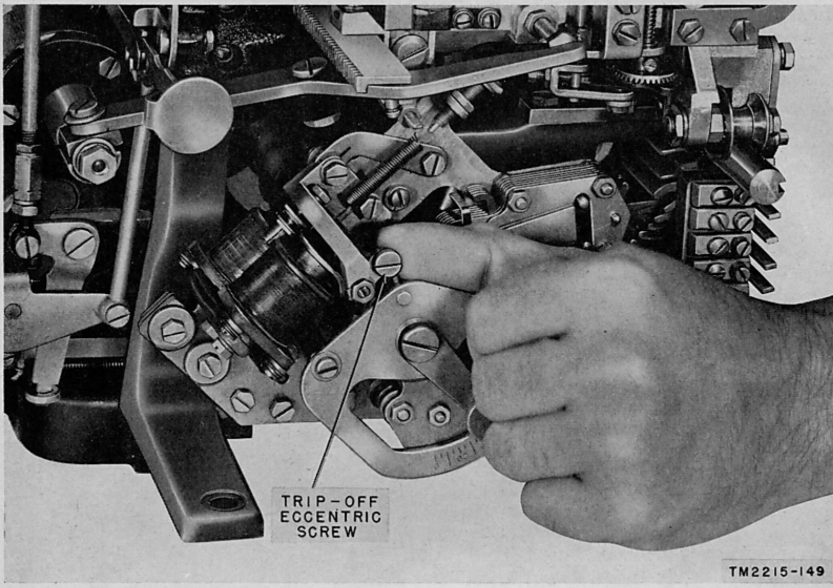


Figure 157. Holding selector armature to mark position by hand.

(2) Loosen the trip-off eccentric screw and turn it until the screwhead does not touch the trip-latch plunger. If the selector-cam sleeve does not stop rotating, the trouble is in the stop lever.

(3) Remove the typing unit, and turn the main shaft manually while holding the stop lever so that it does not rotate. If the selector-cam sleeve is stopped after each revolution, the trouble may be in the trip latch or in the trip-latch spring.

c. MAIN-SHAFT CLUTCH THROW-OUT LEVER. If the selector-cam sleeve does not rotate when the selector armature is in marking position, but the printing and function-bail cams continue to rotate, the trouble is in the clutch throw-out lever.

(1) With the typing unit removed and the selector armature held in the mark position, rotate the main shaft slowly and examine the clutch throw-out lever.

(2) If the clutch throw-out lever does not engage the clutch throw-out cam, check for a missing spring or a broken or missing clutch throw-out lever.

(3) If the clutch throw-out lever does engage the cam, check the clearance between the clutch jaws.

155. Locating Trouble When Transmitter Runs Open

If the transmitter runs open, make the following checks on the transmitter clutch throw-out lever.

a. See if the clutch throw-out lever engages the throw-out cam. The clutch throw-out lever spring may be missing or the clutch throw-out lever may be binding.

b. Adjustment of the clutch throw-out lever eccentric.

c. Adjustment of repeat space rod.

156. Page-Printing Unit Scrambles Letters and Functions

a. There are several possible sources of trouble, external to the teletypewriter unit, that can cause scrambling of letters and functions. Such trouble may be due to the external line characteristics, improper line current, wrong speed, or other defects in a distant teletypewriter or external relays which cause a biased signal to be received even when the signal is sent with the pageprinting unit keyboard. To eliminate line troubles, set up a dummy signal circuit as explained in paragraph 146*e*.

b. If a second teletypewriter unit in good working condition is available, the trouble can be localized to a given unit by replacing the major units of the defective unit with units from the equipment that is working properly. Adjustment of gears and points of contact with a new unit must be checked before running.

157. Testing Page-Printing Unit With a Test Circuit

Adaptations of test circuits will vary with the experience of repair personnel. The sequence of testing given below is recommended for general use by all personnel involved in the repair of teletypewriters.

a. Set up a test circuit as explained in paragraph 146*e*.

b. Type test sentences to see if errors still occur.

c. With the cover removed, check the code position of the vanes for each letter or operation. See figure 5 for the teletypewriter code. The first five vanes (counting from the top down) set up the code, and the front edges of the vanes are tilted down for a mark signal and up for a space signal. The front edge of the sixth (bottom) vane tilts down when the platen is in the LTRS printing position and up for the FIGS printing position. The platen should move up or down to correspond with the desired function.

d. Use the RY combination to get complete reversal of the five selectors and vanes. Any vane that is sticking can be readily detected.

e. With the motor switch turned to OFF, operate the R and Y keys and slowly turn the motor in its normal direction of operation. Watch the operation of the selector unit and the selector armature. Poor transmitter contacts or contact adjustment may cause one or more of the transmitter contacts to space instead of mark.

f. With the typing unit removed, hold the vanes in the proper code positions for letters that will not print correctly, and turn the main shaft by hand. If the letter is not operated, check the code bars to see if they are sticking, or determine if the bell cranks require adjusting.

g. If no results are obtained from the test described in *a* through *f* above, the trouble is probably in the adjustment of the selector unit. After checking the tension of the selector armature spring, make a complete adjustment of the selector unit according to the requirements given in section VII of this chapter. Trouble in the selector unit will probably be evident only if the teletypewriter is power-driven.

158. Locating Trouble When Certain Functions Do Not Operate Correctly

If a teletypewriter operates correctly with the exception of one or two functions or letters, the trouble usually is in the adjustments and parts common to the operation of only these functions or letters. In such cases, trouble seldom is found in the selecting mechanism, the vanes, or the code bars. The trouble can be located quickly by the following action:

a. With the typing unit removed, set the vanes by hand to the code of the faulty function or letter, and set the platen in the proper position, making sure that the sixth vane is also in the proper position. Turn the main shaft until the function and printing bails have been operated.

b. Watch the operation of the function lever or the code bars concerned. If the function lever operates, but the function is not completed, examine the function bail as the main shaft is turned again. The trouble can be found by progressively following the action of the levers from the function lever to the final action of the function.

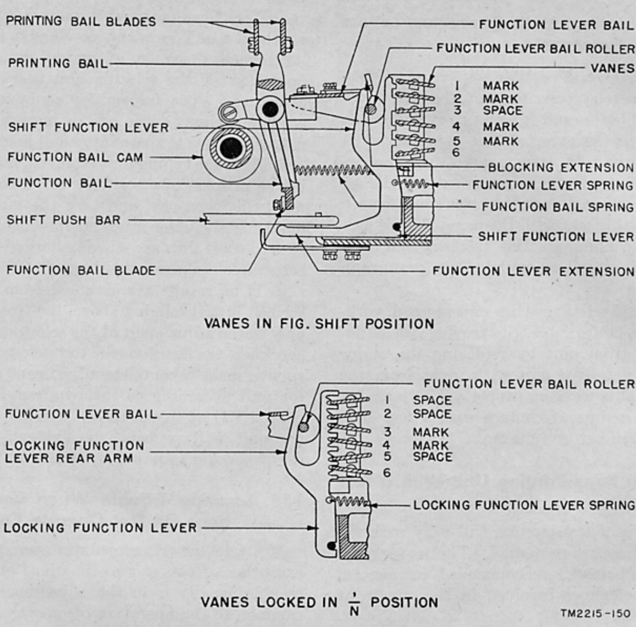


Figure 158. Vanes locked in position.

Section V. REPAIRS AND REPLACEMENTS

159. General Repair Information

a. This section deals with the repairing and replacing of defective teletypewriter parts but does not duplicate information on preventive maintenance procedure. The repair instructions are not intended as a complete shop guide, which lists every possible operation that may be necessary in large scale dismantling and repair of salvaged teletypewriters. The procedures are intended to prescribe the operations involved in replacing and repairing those parts, assemblies, and units subject to the greatest amount of wear.

b. Because of variations in service needs and in the repair and supply facilities available, definite rules cannot always be given specifying exactly which parts, assemblies, or units should be repaired and which should be replaced. As only a limited number of the many small teletypewriter parts can be satisfactorily repaired, the repair instructions consist primarily of detailed disassembly, cleaning, replacement, reassembly, adjustment, and lubrication instructions. These are the procedures that are to be followed in overhauling a complete teletypewriter, or when repairing a single unit or assembly. Actual repair instructions are for those parts and assemblies which can be satisfactorily repaired under normal conditions.

c. Major overhauls and replacements must be accomplished through the use of experienced personnel who possess good mechanical judgment in making adjustments and in replacing the parts which do not need adjustment requirements. Keep the following factors in mind when determining which methods to use for repair and replacement operations.

(1) Skilled maintenance service must be applied to obtain efficient, dependable service from the equipment.

(2) Generally there is no adequate substitute for the conscientious effort of skilled personnel. To obtain the best service possible without the aid of highly skilled personnel (emergency conditions only), it is necessary to use only new or thoroughly rebuilt equipment with stand-by spares ready to be substituted into service in case of failure.

(3) Replace, if possible, any part that shows signs of wear or damage or does not meet adjustment requirements. Written requirements must be supported by the senses of touch, sight, and hearing to determine which part or assembly of parts should be replaced. Where there is a close relationship and interdependency of overlapping functional parts it is impossible for even the most experienced personnel to accurately estimate the life expectancy of a part that is worn or damaged.

(4) A slight decrease in the quality of major repair work will contribute toward an accumulation of troubles and will greatly increase the requirements for skilled labor and/or extra equipment necessary to maintain service.

d. Except in cases of extreme emergency, all repairs to teletypewriters should be made by personnel who are thoroughly trained in teletypewriter maintenance. *It is as important to know what not to do as what to do when making teletypewriter repairs.* Equipment operating with minor faults may fail completely as a result of the failure of inexperienced personnel to correct apparent simple defects.

e. Inspecting, cleaning, and lubricating, while repairs are being made, should be performed in accordance with procedures described in chapter 3 and the additional instructions contained in this chapter.

160. Indexing of Repair and Replacement Procedures

Refer to the general index of this technical manual to find the paragraphs in this chapter that contain detailed repair and replacement instructions. Paragraphs are grouped by related topics under the general heading for each of the principal assemblies.

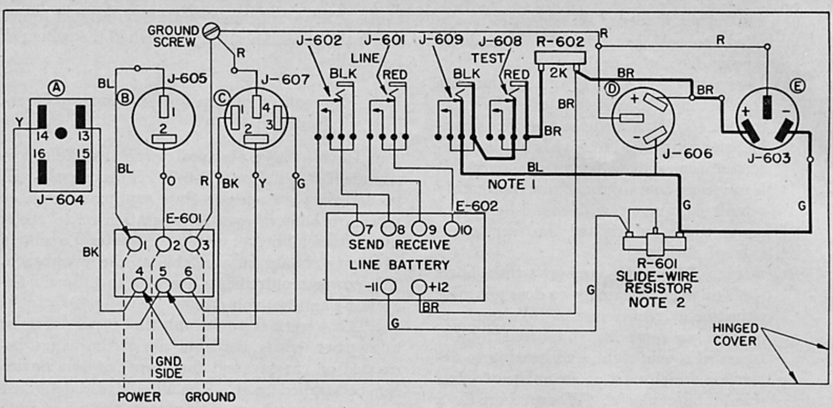
161. Operation of Equipment During Overhaul

a. During major overhaul or repair of Teletypewriters TT–5/FG or TT–6/FG it frequently will be necessary to operate these equipments under power to observe over-all operation or to check certain assemblies or parts. Therefore, a source of power should be available at the workbench. The power requirements are 110- to 115-volt, 60-cycle a-c and 120-volt d-c.

b. If the rectifier power unit that is part of these teletypewriters is available, a-c of the values indicated on the tap and fuse panel of this device can be applied to it. The filtered d-c delivered by this unit can be used to operate the d-c circuits of the teletypewriters. If the rectifier power unit is not available for use, the motor units can be operated directly from the a-c source provided it has the characteristics stated in *a* above. To use d-c to operate the local or signal circuits of the teletypewriters, provide a means of adjusting the current to 60 ma. The table that is part of these teletypewriters has a local test circuit that includes resistors for adjusting line current. If the table is not available for use, a local test circuit may be erected at the workbench by simulating the circuit constants and connecting facilities shown in the schematic diagram of the table (fig. 159). To operate the keyboard-transmitter and typing unit, these units must be installed upon the base with the motor unit in place. Connections for the a-c and d-c circuits are made to the power block of the base as outlined in paragraph 115.

162. Preparation for Disassembly and Dismantling

a. PREPARATORY. Cover the top of the workbench with clean, heavy paper, or other suitable material, to protect mechanisms of the equipment, and to catch small parts or hardware that may drop out during repair. In addition, prepare several small boxes, or other suitable containers, appropriately labeled, so that small parts can be kept together. This will prevent their loss or the mixing together of parts of different mechanisms. Arrange the tools and materials so that



NOTES:
1. HEAVY LINES INDICATE LOCAL TEST CIRCUIT.
2. ZERO TO 2500 OHM SLIDE-WIRE RESISTOR ADJUSTED TO 1700 OHMS AT FACTORY.

TM2215-151

Figure 159. Local test circuit of table.

they will be readily accessible. Set the containers in which special cleaning operations are performed so that they will not be easily overturned. Protect the equipment against dust and dirt.

b. DISASSEMBLY.

Caution: Disconnect all power and signal conductors from the equipment. Never handle live conductors with the bare hands. Observe safety precautions at all times.

(1) Remove paper and ribbon.
(2) Clean any excess grease, oil, or dirt from around the nuts or screws that must be loosened or removed, so that the tools will fit them properly.
(3) Disassemble the equipment in the following sequence:
  (*a*) Typing unit cover.
  (*b*) Keyboard.
  (*c*) Typing unit.
  (*d*) Motor unit.
  (*e*) Base (including relay).
  (*f*) Rectifier power unit.
  (*g*) Table.

c. DISMANTLING. The term *dismantling* is used here to indicate the removal of various major assemblies or subassemblies of each component. The term *disassembly* is used to indicate the actual *taking apart* of the various linkages, or mechanisms, within each assembly or subassembly.

(1) Proceed to disassemble the various parts and assemblies using the tools designed for each particular item. *Do not disassemble any units or assemblies beyond the point necessary to thoroughly inspect and clean the entire mechanism and repair or replace any defective part.*
(2) Place small parts in an appropriate container marked to identify them.
(3) Refer to the index in appendix II for illustrations showing the location of parts and part numbers.
(4) The sequence in which the work is completed may be varied in any manner that will speed up the repair process without sacrificing quality. Experienced mechanics frequently prefer to complete the cleaning, washing, drying, etc., of as many parts as possible before starting to repair, adjust, or lubricate the various units. This allows an early and accurate appraisal of the number of parts requiring attention or replacement and the amount of time required to complete the work.

163. Special Cleaning Procedures

Equipment that has been disassembled for major overhaul can be thoroughly cleaned by brushing and immersing the parts in containers of the appropriate cleaning fluids.

Caution: Do not immerse equipment wiring, resistors, the motor armature, or the motor windings.

a. Cleaning Materials. The following cleaning fluids, normally available through supply channels, are satisfactory for the purposes described below.

(1) Use a soap and water solution to remove nonoily dirt from nonelectrical rubber and cellulose (plastic parts).

(2) Use cleaning compound, Signal Corps stock No. 6G236, to remove oil, grease, and gummy deposits. Soak for 10 to 15 minutes and then flush with very hot water.

(3) Use solvent (SD) to remove oil, grease, and gummy dirt.

(4) Use carbon tetrachloride only for cleaning electrical contacts.

(5) Use diacetone alcohol to remove ditto ink or hectograph ribbon stains from metal, rubber, or cellulosic parts. Be careful to use very little of this cleaning chemical on cellulosic or similar plastic materials. Such materials are readily dissolved in diacetone alcohol. Therefore, never use diacetone alcohol full strength, and never allow it to remain on a cellulosic surface any longer than is absolutely necessary. *Above all* do not open a container of this fluid in the presence of a flame, and do not breathe its fumes.

b. Drying.

(1) *Wiping.* Individual parts can be dried with a clean, dry cloth. Be careful to dry the cleaning fluid from all crevices.

(2) *Oven drying.* Dry the parts in an oven adjusted to maintain a temperature of about 160° F. Such an oven can be improvised by using electric lamps, or heater coils, and a metal box. Appropriate current control resistors or rheostats can be used to adjust the temperature of the improvised oven. Leave the parts to be dried in the oven from 1 to 2 hours.

164. Inspection Procedure

a. General. Inspection procedure for a major overhaul of the equipment includes all the items listed in the preventive maintenance checklist in chapter 3 of this manual, together with additional items that may be inspected while the teletypewriter is disassembled. Inspection will be made to determine which parts can be reused, which require repair, and which must be replaced. If the teletypewriter is damaged during shipment, it may be necessary to disassemble and inspect only one of the principal units and give the remainder general preventive maintenance inspection.

b. Frequency of Overhauls. Wide variations in the age and general physical condition of a teletypewriter, and the experience of organizational maintenance personnel who perform preventive maintenance work, will affect the need for overhauling the equipment. Differences in the climatic conditions under which the equipment is operated will also affect the length of time between major overhauls. Do not completely disassemble the teletypewriters until the regular preventive maintenance inspection shows that wearing of parts requires disassembly. Teletypewriters operating 8 to 12 hours per day will ordinarily not require a complete overhaul by field repair shops more than once in 6 or 8 months. Teletypewriters operating less than 8 hours per day may be maintained in such condition that a complete overhaul is not warranted even after a year of service. Very old or well-worn equipment, however, may require a major overhaul every third or fourth month if it is operated in tropical regions. In all cases the thoroughness of the preventive maintenance work performed by organizational personnel is the principal factor in determining how frequently the teletypewriter must be taken out of service and returned to field shops for a major overhaul.

c. Procedure.

(1) Make the inspection, incidental to repairs, after all parts have been thoroughly cleaned. Include all related items listed in the preventive maintenance checklist (par. 62).

(2) In addition to the preventive maintenance inspection, include a thorough inspection of the wearing surfaces of gears, cams, levers, springs, bearings, etc., which

can be inspected only after the equipment is disassembled.

(3) While the parts are disassembled, make a thorough inspection of the surfaces of all castings and supporting parts to determine whether breaks or cracks exist.

(4) Inspect the condition of all wiring, insulating strips, and terminal boards, while they are accessible.

(5) Carefully check the surface condition of all clutches, commutators, contacts, etc., and the end play of bearings as instructed in other paragraphs of this section and in related paragraphs in the requirements and adjustments section.

165. Reassembly Procedure

Reassemble all parts, subassemblies, and units in accordance with the following provisions:

a. Replace all worn or broken parts that cause malfunctioning of a teletypewriter. While the equipment is disassembled for checking or repair, replace any parts so worn that they may cause trouble before the next complete overhaul.

b. Assemble replaced parts and associated parts firmly and securely. Carefully tighten all screws, nuts, and bolts.

c. Readjust all parts that are replaced or disturbed during repairs. Make the necessary readjustments during or immediately after reassembling.

d. When dented or flattened areas prevent proper turning and adjusting, remove the faulty part, and repair or replace it.

e. Restore bent or distorted parts to shape. Such parts may be reused, provided that repairs have not resulted in cracks or softening of hardened surfaces which may cause future service failure.

f. If the locking edges of lockwashers removed during repairs are rounded, replace the lockwashers. New lockwashers are always better.

g. Replace all stripped screws or nuts and those with damaged heads.

h. When screws, nuts, or other parts are secured in place with locknuts, do not remove or loosen these parts without first loosening the locknut, because such procedure can very easily damage threads.

i. Remove slivers and sharp burrs that are a hazard.

166. Removal and Replacement of Principal Teletypewriter Units

Major assemblies of these teletypewriters are removed or replaced as follows:

a. Type-Bar Carriage. Always remove the typing unit before removing the type-bar carriage from it or before restoring it to the typing unit.

(1) *Removal.*

(*a*) After the platen crank and typing-unit cover have been removed, loosen the two captive screws that hold the keyboard in place and remove that assembly. Remove the three large, flat-knurled screws that hold the typing unit to the base and carefully lift the typing unit off the base. Set the typing unit on the workbench so that it is supported by the three hexagonal studs on the bottom of the unit.

(*b*) Operate the carriage-return lock bar (fig. 160) and move the type-bar carriage to the extreme right. Operate the dash-pot lever; this locks the carriage in its extreme right position.

(*c*) Remove the draw strap by grasping the carriage-return drum in one hand so there will be less strain on the draw strap. With the other hand, remove the strap from its retaining pin on the carriage, and hook the eyelet at its end on the margin-bell hammer stop post.

(*d*) Operate the right margin adjusting screw to the rear.

(*e*) Operate the carriage-return lock bar again, and the carriage will slide off to the right.

(2) *Replacement.*

(*a*) Shift the platen to the figures position and rotate the main shaft until the printing bail is in its rearmost position.

(*b*) Move the right margin adjusting screw arm, on the carriage, to the rear so that it is approximately 45° from vertical.

(*c*) Hold the carriage in the right hand and rest the *left* front support roller on the *right* end of the front carriage track. Be sure that the carriage-guide screw engages the slot in the front carriage track.

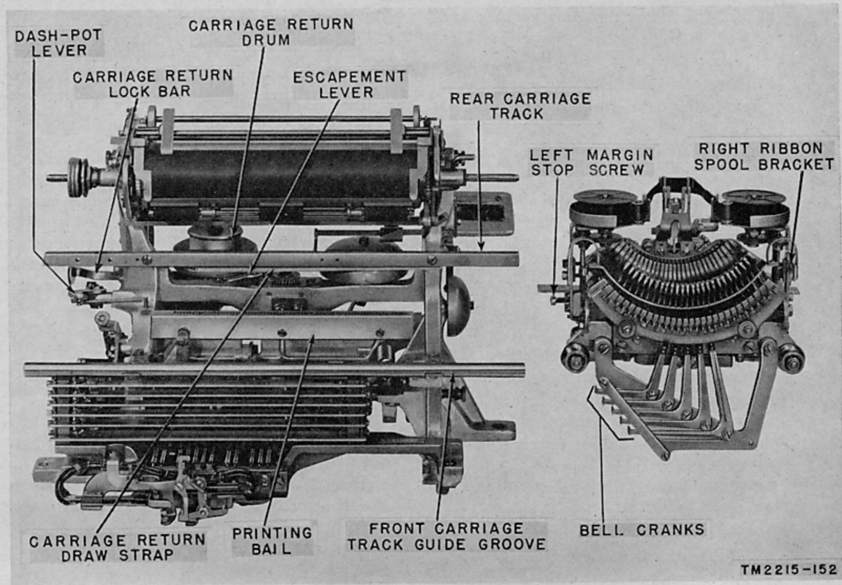


Figure 160. Removal of type-bar carriage.

(*d*) Move the carriage slowly to the left until the rear carriage-support roller rests on the rear track.

(*e*) Operate the carriage-return lock bar, and move the pull-bar bail to its farthest rearmost position by pushing the right pull-bar bail roller with the right thumb.

(*f*) Move the carriage farther to the left. See that the bell cranks (fig. 160) engage their respective vanes. Also be sure that the *right* front carriage-support roller and guide screw engage the *front* carriage track properly, and that the pull-bar bail plunger roller is between the printing-bail blades.

(*g*) When the carriage has been moved far enough to the left to permit the right margin adjusting screw to clear the spacing stop lever, restore the right margin adjusting screw to its normal vertical position. Shift the carriage to its extreme right position and lock it in place by operating the dash-pot lever.

(*h*) Hold the carriage-return spring drum so as to prevent the spring from unwinding.

(*i*) Unhook the eyelet of the draw strap from the margin-bell hammer stop post, and hook it over its mounting post on the carriage.

(*j*) Operate the carriage-return lock bar to permit the carriage to return to its extreme left position.

b. Motor Unit.

(1) *Removal.* Unscrew the three motor mounting screws that hold the motor unit to the base. Remove the motor unit.

(2) *Replacement.* After repairs to the motor unit have been completed, or if it is necessary to install a new motor unit, proceed as follows:

(*a*) Set the motor unit on the base and push it back against the spring contacts.

(*b*) Insert the three mounting screws in the mounting holes in the base plate.

(*c*) Tighten the two front screws and then back them off about 1/4 turn. Do not tighten the rear mounting screw until the typing unit is in place. Adjust and tighten.

c. Typing Unit.

(1) *Removal*. Remove the typing unit as described in *a*(1) above.

(2) *Replacement*. The typing unit is installed after the motor unit is in place. After necessary repairs and adjustment of the typing unit replace it as follows:

(*a*) Lower the typing unit in place on the base, and be careful that this operation is performed without damage to the gears or contact springs.

(*b*) While lowering the typing unit in place, turn the motor by hand to insure that the gears are properly meshed. (Refer to par. 365 for requirements and adjustments of the main-shaft drive gear clearances.)

(*c*) Insert and tighten the thumbscrews that secure the typing unit to the base.

d. Keyboard-Transmitter.

(1) *Removal*. Refer to *a* (1) above.

(2) *Replacement*. Slide the keyboard into the opening in front of the typing unit and base. Be careful not to place any undue strain upon it that might distort the mechanical linkages or throw them out of adjustment. Refer to paragraph 13*f* for installation procedure for the keyboard-transmitter.

e. Typing Unit Cover (Including Copyholder). Place the typing unit cover over the typing unit and the base. Ease it down gently so as not to tear the padding with which the cover is lined. Refer to paragraph 14 for instructions for installation of ribbon and paper.

f. Rectifier Power Unit. Lift the rectifier power unit onto its shelf in front of the table. Complete the electrical connection to this unit.

167. Repair of Motor Units

a. Motor units should be completely disassembled and overhauled *only* when the motor gives trouble, and then only by specially trained personnel who are equipped with the necessary test equipment and proper tools.

b. Overhaul should include complete disassembly and cleaning of the motor, inspection and repair, or replacement of burned governor contacts, worn end-ring, worn commutator brushes, grooved or worn commutators, worn motor bearings, or poor insulation. The motor need not be completely disassembled to replace or repair brushes or governor parts. These may require repairs or replacement more frequently than once every 6 months.

168. Disassembly of Motor for Major Repairs (fig. 163)

Disassemble the motor for repairs in the following sequence of steps:

a. Remove the motor unit from the base unit (par. 166*b*). Remove the brush-holder caps and the brushes. Remove the governor brush bracket assembly, and the motor connection block (motor terminal contacts) (fig. 47).

b. Remove the motor unit from the motor base plate by removing the four mounting screws. Remove the motor pinion and the governor. Be careful not to lose any of the shims that may be on the armature shaft between the governor hub and the end frame casting of the motor.

c. Remove the external bearing retainer screws.

d. Remove the motor frame bolts or screws, and separate the parts by prying gently with the blade of a screw driver. Lift out the armature. Be careful not to drop the armature or damage the windings. Do not lose any of the parts such as bearing retainers, spring washers, etc.

e. Remove the armature bearings using the bearing puller (fig. 144) (Signal Corps stock No. 4T84020). This tool is not furnished as part of Tool Equipment TE–50 or TE–50–A.

Caution: Use the bearing puller carefully on bearings that have a built-in dust shield. Position the bearing puller so that pressure is exerted on the outer bearing race *only*. Pressure applied to the dust shield will crush the shield and destroy the bearing. *Never attempt to pry the bearings off with a screw driver.*

169. Special Cleaning Instructions for Motor

The instructions given in this paragraph are for cleaning the internal parts of the motor.

a. Disassemble the motor (par. 168).

b. Clean all dust, paper lint, nonoily dirt, etc., from the armature and stator windings by brushing carefully with a clean, dry sash brush. *Do not damage the windings.*

c. Remove all oil, grease, or gummy deposits from the face of the armature and stator by wiping with a piece of cheesecloth, dampened with solvent (SD). *Do not use too much solvent (SD).*

d. Clean the end frames, bearings, motor pinion, and any other metal parts by immersion in a container of appropriate cleaning fluid (par. 163). Be sure to dry and lubricate the parts as directed.

e. Clean all dust, dirt, oil, grease, gummy deposits, or other foreign matter from the commutator by rubbing with a piece of cheesecloth dampened with carbon tetrachloride. Be careful not to damage the windings. The copper segments of the commutator may become quite dark and discolored. This discoloration is due to the imbedding of particles of carbon (from the brushes) in the copper which greatly increases the life of the commutator segments. *Do not* polish the commutator to remove this discoloration unless it has become so deeply grooved, or unless it causes such excessive sparking at the brushes, as to require refinishing. Refer to paragraph 171 for information on resurfacing the commutator.

170. Replacement or Repair of Motor Armature

a. After long periods of operation, the commutators of series-wound motors become worn and grooved by brush wear, and they require resurfacing, as described in paragraph 171. If the surface of the commutator is not deeply grooved and has an even, smooth, grayish coating of oxide, resurfacing is not required unless there is excessive sparking at the brushes when the motor is under load.

b. If there is excessive sparking of brushes on a commutator that is not grooved or pitted, clean it with a cloth moistened with carbon tetrachloride, turning the shaft over by hand after the brushes are removed, as described in paragraph 172.

c. If there is still excessive sparking, remove the armature from the motor and clean the commutator by lightly applying No. 0000 sandpaper. To do this, wrap a piece of sandpaper around the commutator and rotate the armature in a lathe or between other fixed centers, holding the sandpaper against the rotating commutator very lightly.

d. Inspect the commutator carefully to determine if it is necessary to undercut the separating insulators between the segments. The top of the insulating material must be below the level of the commutator bars on either side. This is necessary to prevent small carbon particles from lodging in the separators and building up to a point where the adjoining commutator segments or bars will be short-circuited.

e. Organizational maintenance personnel should replace the motor when the commutator requires resurfacing. Field repair personnel should complete repairs or replace the motor in accordance with local instructions.

171. Resurfacing Motor Commutators

When authorized by local instructions, the commutator may be resurfaced by experienced personnel as follows:

a. Refinishing Commutator Surface.

(1) Mount the motor armature between centers on a lathe so that the armature shaft does not run out of line more than 0.0005 inch. Place a sharp cutting tool in the tool rest and set the tool rest so that only light cuts will be taken. Take a series of light cuts across the entire width of the commutator by moving the tool rest up and down the length of the lathe. Generally, movement of the tool rest will be automatically controlled by a worm gear on the lathe. Be very careful not to make deep cuts in the commutator. Continue to cut away metal until the grooves and rough spots on the surface of the commutator are eliminated. *Do not remove any more metal from the commutator than is absolutely necessary.*

(2) Polish the commutator with a strip of fine sandpaper (No. 000 or No. 0000) held in flat contact with the commutator as the armature revolves in the lathe. *Never* attempt to smooth a rough commutator with sandpaper unless this work is done in a lathe, or between similar fixed centers. *Never* use emery cloth or carbo-

rundum paper. Loose particles from such abrasives will cause trouble in the electrical circuits.

b. Undercutting Commutator Bar Separators (Insulators).

(1) Tool equipments available at larger repair shops may include any one of several types of undercutting tools. Do not attempt to use such tools until the directions furnished with them have been carefully studied.

(2) If no standard undercutting tool is available, improvise a substitute from a piece of hacksaw blade, as follows:

(*a*) Grind the sides of the cutting edge of the hacksaw blade until the total width of the teeth is a little less than the width of the slot between the commutator segments.

(*b*) Fit a wooden handle to the unground portion of the blade to protect the fingers against injury.

(3) Hold the improvised tool at an angle so that only one or two teeth are in contact with the separator material, which is usually mica. Draw the tool—in a direction away from the windings—and cut away a portion of the separator. Repeat the process until the surface of the separator material is $\frac{1}{64}$ to $\frac{1}{32}$ inch below the surface of the adjacent metal commutator segment bars, uniformly, along the entire slot. Repeat for all the separator slots in the commutator. *Be sure that there are no slivers of metal remaining in the slots after the cutting process.* Such slivers will short-circuit the commutator segments and burn out the windings when the motor is started.

172. Replacing Motor Brushes

a. When removing the brushes, mark the upper surface so that the brush may be replaced in its holder with the same side uppermost. If the brush has a number stamped on the upper side of the carbon, this number may be used as a guide.

b. Inspect the brushes as follows:

(1) See that at least $\frac{5}{8}$ inch of brush material remains.

(2) Be sure that at least one-third of the brush face bears upon the commutator surface.

(3) See that the brushes make contact across at least 75 percent of the long dimension of the brush face.

c. If the above requirements are not met, substitute a new brush which will seat properly.

173. Surfacing and Installing Motor Brushes

To shape the contact face of the brush to the curvature of the commutator proceed as follows:

a. Wrap a piece of No. 0000 sandpaper around the commutator under the brush holder.

b. Insert the brush in the brush holder with the numbered or marked side uppermost, so that the brush bears against the sandpaper under the normal pressure of the brush spring.

c. Rotate the armature back and forth by hand, so that the sandpaper will wear a surface of proper curvature in the contact face of the brush. The last rotation of the armature should be in the direction in which it would turn during operation of the motor.

d. After the proper curvature has been cut in the brush face, remove the brush from the brush holder. Bevel the edges, slightly, using sandpaper.

e. Wipe the brush with a cloth moistened with carbon tetrachloride.

f. Examine the brush spring to see that it is in good condition. See that the pigtail within the brush spring is intact and free of kinks, and that it will permit the spring to extend properly.

g. Clean out the brush holder. To do this use a piece of cloth moistened with carbon tetrachloride wrapped around a stick or an appropriately shaped tool such as a screw driver. Be careful not to score the sides of the brush holder.

h. Reinsert old brushes in brush holders from which they were removed for resurfacing. See that a brush is restored in the same position that it occupied before removal, with the numbered or marked side uppermost.

i. Always insert a new brush that has just been resurfaced with the numbered side uppermost.

j. See that the brush moves freely in the brush holder. Check the pressure of the brush springs and see that they meet the specified requirements.

174. Replacing Armature Bearings

a. General. Install new bearings if those in use are burned, cracked, badly worn, or damaged in any way. Handle the bearings carefully. See that no dirt gets into the bearing races. Lubricate all bearings including used bearings that are found to be in good condition when cleaned and inspected. Apply grease to new bearings before they are installed on the shaft. In addition to its lubricating properties, the grease prevents dirt from entering the bearings. Place a paper washer over the exposed side of the bearing to further prevent dirt or dust from entering.

b. Installation of Bearings. The following procedure outlines a typical method of installing bearings on the armature shaft.

(1) *General.* Bearings fit tightly upon the armature shaft. Therefore, they must be pressed onto the shaft with an arbor press, vise, or similar tool. Such tools are normally available at field repair shops. It is important to see that the bearing is pressed onto each end of the shaft carefully, so that the pressure exerted by the press or vice will not bend the armature shaft or force the bearing on the shaft at an angle to the axis of the shaft.

(2) *Preparatory.* Prepare two blocks of hardwood, equal in length and about 1 inch longer than the armature shaft extension. Shape one end of each block so that it will not bear against the ball bearing or outer race of the bearing. Prepare another block (fig. 161) large enough to be used against the rear jaw of the press or vise. Slip a bearing onto each end of the shaft as far as it will go, fingertight. Be careful to see that the bearings are at right angles to the axis of the armature shaft.

(3) *Installing.*

(*a*) If the bearings have dust covers see that the dust cover of each bearing is nearest the winding. Place the two wooden blocks of equal length at either side of the armature shaft extension (fig. 161). Place the other block of wood against the rear jaw of the press or vise. See that the armature is set in the press or vise so that each end of the armature shaft is near the center of the face of each jaw. Tighten the tool very slowly until there is even pressure applied to *both* sides of the bearings. *Be careful not to bend the armature shaft.* Continue to slowly tighten the tool until the bearing is pressed onto the shaft and is against the armature shaft shoulder (fig. 161). Repeat the procedure to mount the bearing on the opposite end of the shaft. Some types of bearings can be

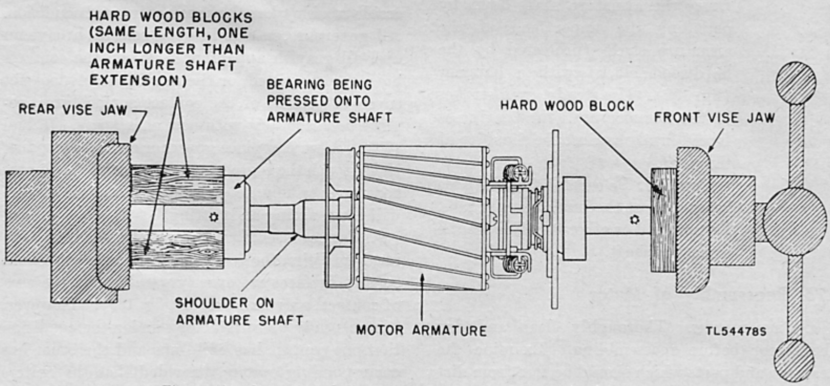


Figure 161. Pressing armature bearing onto its shaft by use of a vise.

taken apart. If possible, disassemble and assemble this type of bearing on the shaft. Then the inner race can be removed and replaced on the shaft with less danger of damage to the other parts of the bearing.

(*b*) When a suitable press or vise is not available, bearings can be installed on the armature shaft, when authorized as a field expedient, by the following method:

1. Slide the bearings on the armature shaft as described in (2) above.

2. Prepare a piece of copper or brass pipe 1 inch longer than the shaft extension (fig. 162) with an inside diameter slightly larger than the diameter of the armature shaft. If copper or brass pipe is not available, an iron pipe can be substituted provided a brass washer is used to protect the inner race of the bearing against the iron pipe. Slip the copper or brass pipe onto the shaft so that it bears against the inner bearing race.

3. Stand the armature on end with the pipe resting on the bench or work table.

4. Place a block of hardwood over the other end of the armature shaft. Drive the armature shaft down by pounding the upper end of the armature shaft (protected by the hardwood block) with a hammer (fig. 162). Use steady, even strokes of the hammer until the bearing is forced firmly against the shoulder of the shaft.

Caution: Be careful that the pipe bears against the inner bearing race. Do not bend or otherwise damage the armature shaft.

175. Reassembly of Motor

a. Preparation. Thoroughly clean and dry the motor before reassembling. Examine the bearings and parts which should be free from dirt before beginning to reassemble the motor.

b. Step-by-Step Reassembly.

(1) Position the bearing retainer so that the holes match the positions of the retainer screws.

(2) Insert the armature into the stator so that the bearing on the shaft, opposite the commutator end, enters the end frame section. Do not use force because the bearing should fit easily into the end frame section.

(3) Remove the brushes from the end frame section that fits over the commutator. Place the end frame section on the commutator end of the shaft. Gently tap the end frames into position.

(4) Insert the motor frame bolts. Tighten the opposite ends at the same time to be sure that the end frame sections are mounted correctly and seated in the motor frame.

(5) Use a toothpick, piece of wire, or any other convenient means to move the bearing retainer ring into position so that the bearing retainer screws can be started. Tighten both retainer screws at the same time.

(6) Replace the motor pinion and pilot screw; then replace the governor and its pilot screw.

176. Governor Repairs

a. General. Governor contacts cause considerable trouble when they are not in good condition. All governor contacts in good condition have an over-all grayish appearance. When the contacts have become pitted, or the grayish color does not cover 75 percent of the contact surface area, replace *both* contacts with new ones (pars. 178 and 179). Always replace governor contacts in pairs. Never touch the contacting surface with the fingers because even minute deposits of moisture or dirt will cause arcing and pitting.

b. Contacts in Satisfactory Condition. The ideal condition for governor contacts is when both contact surfaces are exactly parallel and the area of contact is a maximum (A, fig. 165). However, contacts may be satisfactory under the condition that one contact has build-ups and the other has corresponding craters, provided that the craters will accept the build-ups (A, fig. 165), and thus

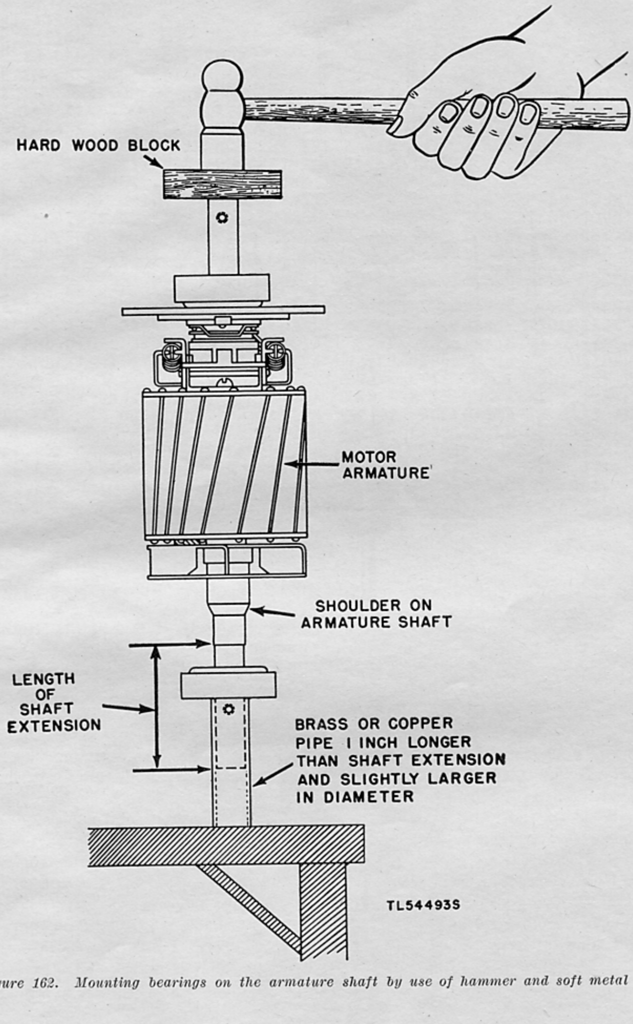


Figure 162. Mounting bearings on the armature shaft by use of hammer and soft metal pipe.

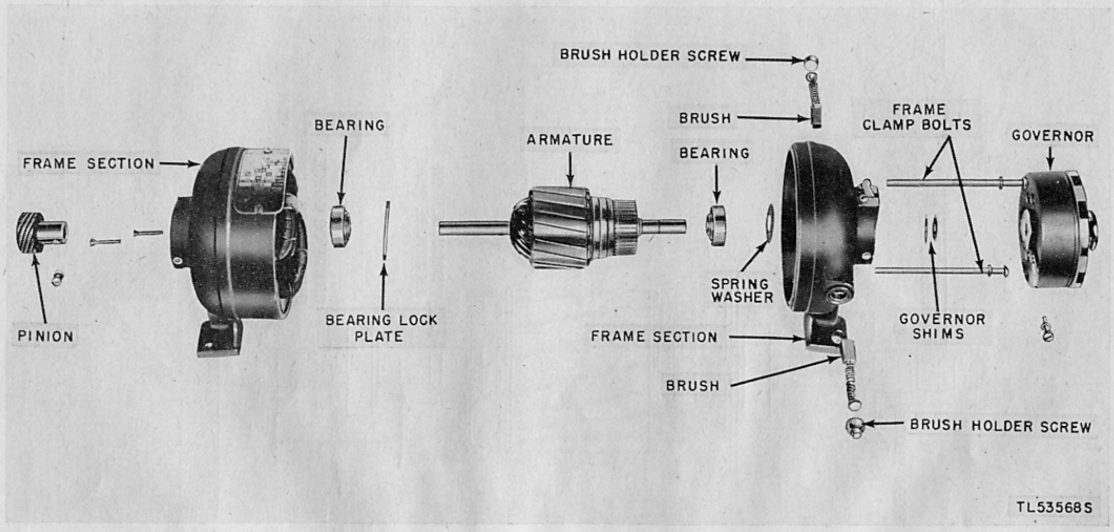


Figure 163. Disassembly of motor.

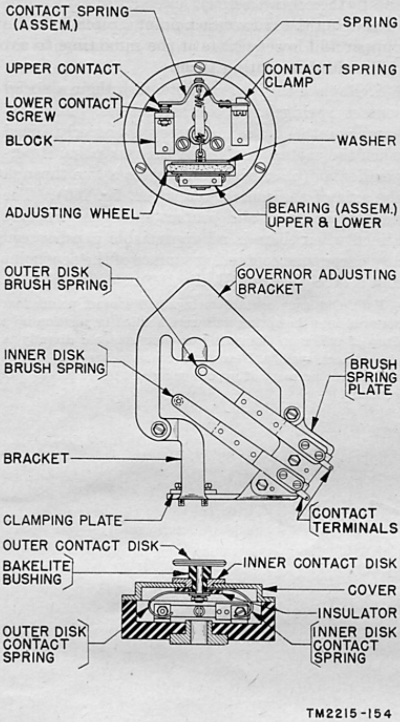


Figure 164. Motor governor parts.

maintain contact over an acceptable area. Contacts in this condition are considered to be good and need not be replaced unless there is trouble in obtaining and maintaining proper motor speed.

c. Common Causes of Contact Trouble.

(1) Trouble due to poor surface contact is frequently the result of a previous attempt to burnish or file contacts to produce better surfaces. In such cases the build-ups have been removed, with the result that the craters that still remain do not meet the renewed surface (B, fig. 165), thus reducing the amount of effective contact surface.

(2) If the contacts are rotated or shifted in position, as shown in C, figure 165, the build-ups and craters will not match. This condition results in extremely erratic motor speed because practically all of the contacting surface has been lost.

177. Disassembly of Governor

When necessary to completely disassemble the governor, proceed as follows:

a. Remove the screw which holds the governor-adjusting bracket to the brush spring-plate bracket.

b. Remove the screw that holds the governor-adjusting bracket to the brush spring plate, and remove the adjusting bracket.

Note. When the governor brush assembly does not require repair, merely loosen the screw (*a* above) and raise the left end of the governor-adjusting bracket so that it pivots on the loose screw located to the right of the governor.

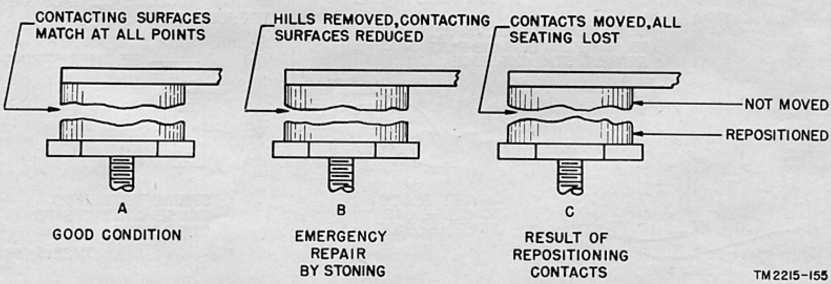


Figure 165. Governor contact surfaces, enlarged diagrams.

c. Remove the screws holding the brush springs in place. Remove the springs.

d. Loosen the screw that holds the governor to the switch end of the rotor shaft. Slip the governor from the shaft.

e. Remove the screws that secure the target and governor cover. Remove the target and cover.

f. Unhook the speed-adjusting spring (fig. 270).

g. Loosen the screw by which the feather spring is clamped to the end of the contact spring (fig. 166). Lift the contact spring out of the governor shell.

h. Remove the nut and lockwasher on the contact screw (fig. 166). Lift out the contact screw.

178. Replacing Governor Contact Points

a. Contact points are made of tungsten. They are welded to the contact spring (upper contact) and to the contact screw (lower contact). When removing the old contact points, replace both the upper and lower points at the same time to avoid difficulties in seating them.

b. Replace the new points with their associated contact springs and contact screws. The new lower point with a contact screw is properly alined when the contact surface of the new point is perpendicular (or at right angles) to a line through the axis of the contact screw (A, fig. 166). The new upper point and contact spring is properly alined when there is no appreciable gap between any part of the contacting surface of the new point and a straightedge (B, fig. 166).

Note. Old style contact springs had contact points that screwed into the spring and were bonded in position by a drop of solder on the spring or were soldered directly to the contact springs. New style contacts are welded and require replacement of upper spring and lower screw with contacts.

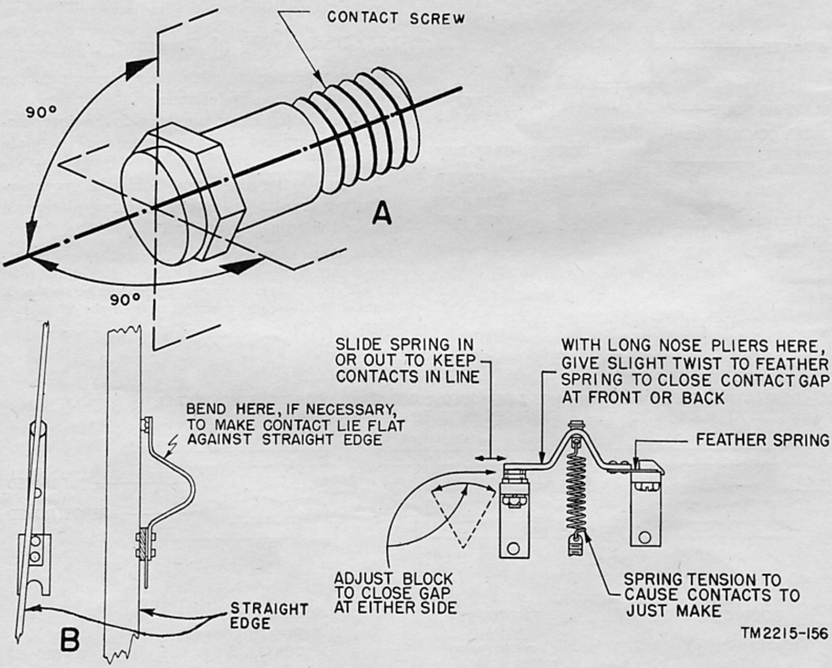


Figure 166. Alinement of new governor contact points.

179. Repair of Contact Points

In emergencies, when trouble is due to build-ups or pitting and new contact points are not available, remove the points and dress them *very lightly* with a fine carborundum stone. Such a stone is part of Tool Equipment TE–50 and TE–50–A. It may be necessary to remove a particularly large build-up by knocking it off with a screw driver and then dressing the contact surface with the stone. When resurfacing a point with the stone, be careful to see that the stone is clean and has a level surface. Hold the point as flat as possible against the surface of the stone. To be sure that the entire face of the point is dressed level, use a rotary motion when dressing the contact point. In this way all parts of the face of the point will be dressed. Do not use too much pressure. Examine the point after every rotation. Stop when the face of the point meets the requirements mentioned in paragraphs 176*b* and 178*b*. Clean the dressed points with carbon tetrachloride. *Replace both points as soon as possible. This is necessary to avoid trouble from build-ups and pitting, which form quickly on resurfaced contacts.*

180. Reassembling Governor

a. Insert the contact screw in the hole in its mounting block. Place the lockwasher and nut on the end of the contact screw. Tighten the nut securely.

b. Insert the feather spring of the contact spring assembly (fig. 166) under the clamp on its mounting block and tighten the clamp screw until the contact spring is held friction tight. The contact should remain slightly separated (approximately 0.005 inch).

c. Hook the speed-adjusting spring onto the contact spring (fig. 270). Turn the adjusting wheel until all tension is released. Contacts should return to the slightly separated position indicated in *b* above.

d. Insert a piece of white paper behind the contacts.

e. Turn the adjusting wheel until the contacts just touch. Use a flashlight or other small bright light to illuminate the contacts during this adjustment.

f. Slide the contact spring to the right or left until the sides of the upper and lower contacts are alined vertically. If a gap can be seen on either side of the contacts, loosen the contact mounting block retaining screw and move the top of the block to the right or left. At the same time shift the contact spring to keep the contact points in line (fig. 166). Tighten both the contact spring clamp screw and the contact mounting block retaining screw.

g. If a gap at the front or back of the contacts is observed, twist the feather spring on the end of the contact spring, using a pair of long-nosed pliers for the purpose (fig. 166). Repeat the above adjustments until the contacts are correctly positioned.

h. Turn the adjusting wheel so that the tension of the spring is near the midpoint of its range.

i. Clean the points with carbon tetrachloride applied with a toothpick or an orange stick. Reassemble the governor cover and target to the governor, and remount the governor on the motor.

181. Inspection, Cleaning, and Repair of Governor Contact Disks

a. Clean governor contact disks with a piece of cloth moistened with carbon tetrachloride. A smooth, even, gray coating of oxide is desirable, and the contact disks should not be disturbed unless there is excessive sparking at the brushes.

b. To remove pits or burned spots from the contact surface of the disks use No. 0000 sandpaper. Hold the sandpaper against the disk surface by hand while the motor is running at normal speed. Hold a piece of cloth with the sandpaper in such a way that cuttings and particles will be immediately wiped away during the sanding process.

c. Never touch the contact surface of the contact disks with the fingers. Minute deposits of moisture or foreign matter will cause arcing and pitting. It is good practice to flush the contacts with carbon tetrachloride immediately after they have been sanded. This can be done by repeatedly applying the fluid to the contact, by means of a toothpick or orange stick, to flush away all foreign matter, grease, or moisture. Be careful to prevent the carbon tetrachloride from coming in contact with wire insulation or plastic parts.

182. Repair and Replacement of Center Contact Governor Brushes

a. Replace the No. 78403 carbon brushes on the tips of the end-ring governor contact springs when

the brushes are worn down to 1/8 inch. Replace the individual brushes (*b* below), when it is not necessary to replace the entire brush assembly.

b. Unsolder the old brush from the spring. Clean away any solder that remains in the mounting hole in the spring from which the brush is removed. Insert a new brush in the mounting hole and solder it securely in place. Clean the brush with carbon tetrachloride applied with an orange stick or toothpick.

c. Restore the governor brush assembly to its proper position and tighten the mounting screws.

183. Testing Repaired Governors

a. After the governor is completely reassembled, seat the new contacts by running the motor on test for at least an hour. Check the speed every 15 minutes and immediately investigate any sudden change in motor speed.

b. If the motor speed is erratic and the trouble cannot be traced to other parts of the motor, disassemble the governor and check the contacts for build-ups and alinement. If build-ups are found, replace the contacts. After the contacts have been properly realined, reassemble the governor and run the motor again for an hour.

c. Proper operation of the governor is indicated if the motor speed does not change appreciably during the hour test run.

184. Keyboard Repairs

a. Inspecting, cleaning, repairing, replacing, and adjusting of keyboard-transmitter parts should be completed with the keyboard-transmitter removed from the teletypewriter.

b. Most of the parts are exposed when the keyboard-transmitter unit is removed from the teletypewriter. Therefore, no special disassembly is required for general cleaning or inspection purposes.

185. Replacement of Transmitter-Shaft Drive Gear

a. Replace the drive gear if any of the teeth are missing, or if the gear is badly worn.

b. To replace the gear, remove the gear pilot screw. Slide the gear from the transmitter shaft. Slide the new gear into place. Replace the pilot screw.

186. Replacing Keytops

a. Replace all keytops that are so worn that they are no longer legible. Also replace all missing keytops.

b. Remove the keytops from the keylevers by turning the tops 1/4 turn in a clockwise direction and by lifting them up. Replace keytops by setting the keytops in the normal position and pressing them down on the keylevers, while supporting the keylevers from underneath.

187. Replacement of Transmitter Shaft, Cam Sleeve, and Clutches

a. Replace the transmitter shaft if it is scored or worn. Replace the clutches if teeth are broken or badly worn. Replace worn cam sleeve if it has been badly scored, or if there is excessive play between the shaft and the cam sleeve.

b. To replace transmitter shaft parts, loosen the bushing adjusting screws nearest the transmitter gear, and remove the bushing. Move the transmitter contacts out of the path of the transmitter cam sleeve, and remove the cam sleeve from the transmitter contacts in the direction of the transmitter gear. Slide the came sleeve, clutch spring, and movable clutch member from the shaft.

c. Replace the new parts in the reverse order in which the old parts were removed (fig. 167).

d. Adjust the transmitter shaft as directed in paragraph 394.

188. Repair or Replacement of Transmitting Contacts

a. Do not clean or burnish transmitter contacts that are working properly. Clean contacts that are out of adjustment or that are causing trouble. Carbon tetrachloride may be used for cleaning transmitter contacts. Remove build-ups with a contact file, and adjust the contacts as instructed in paragraph 382. Refer to TM 11–4302 for maintenance and repair data applicable to electrical contacts.

b. Replace badly burned transmitter contacts and those with broken springs.

c. Whenever possible replace the entire transmitting contact assembly as a complete unit.

d. Dismount the contact assembly by removing the two screws that fasten it to the frame.

e. Remove the wiring to the contact assembly by unsoldering the connections at the terminals.

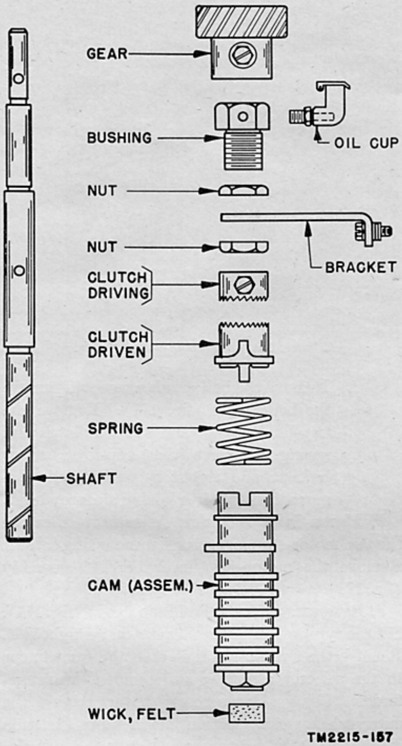


Figure 167. Transmitting-shaft assembly.

Clean the wires of excess solder, attach new contacts, and resolder the connections. Be careful not to change the electrical connections to the transmitter contacts.

189. Repair or Replacement of Other Electrical Contacts on Keyboard-Transmitter

a. General. The electrical contacts of the keyboard, other than the transmitter contacts, are contained in the polar-neutral key (fig. 134).

b. Repair or Replacement. Repair of the electrical contacts (*a* above) normally will consist of cleaning and burnishing the contact points and adjusting the contact springs. Refer to TM 11–4302 which contains much valuable data on the repair and adjustment of spring contacts of the type used in these teletypewriters. When replacement of any of these electrical devices is necessary, replacement procedure will include the unsoldering of all electrical conductors from the various terminal points and the removal of the mounting screws or other hardware. *Always tag the conductors as they are removed so that they can be replaced without confusion.* Save and reuse any lockwashers associated with the mounting hardware. If the insulating materials used in spring-type electrical contacts are broken or so

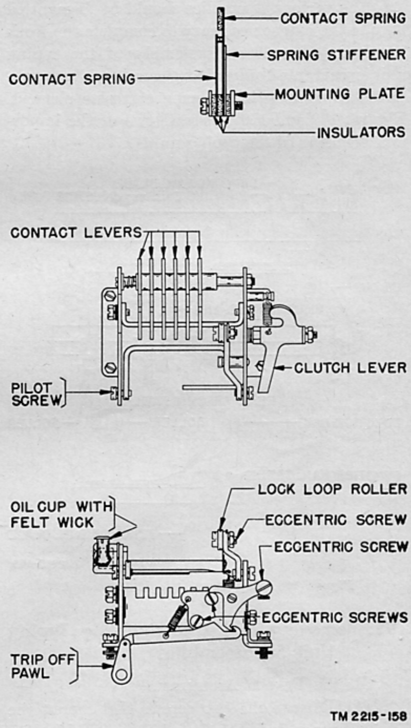


Figure 168. Transmitting contact and clutch throw-out lever assembly.

badly damaged that they can no longer serve their purpose, it is better to replace the entire assembly, if possible, than to attempt to replace the insulators.

190. Typing Unit Repairs

a. Instructions required for a major overhaul of the typing unit are grouped in the paragraphs that follow. These instructions are arranged by principal assemblies and subassemblies for easy reference when repairs to a single item are necessary.

Note. Instructions for repair of the type-bar carriage are contained in paragraphs 196 and 197.

b. The various assemblies should be dismantled only to the extent necessary to complete the work involved. Complete disassembly of the typing unit is warranted *only* when the unit has been subjected to sand, grit, or some corrosive element. Figures 169 and 170 illustrate two of the important elements of the typing unit.

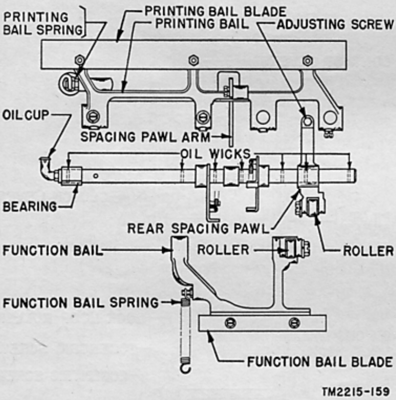


Figure 169. Printing bail, disassembled.

191. Removing and Disassembling Typing Unit Subassemblies

a. Range Finder Assembly.

(1) Remove the two screws that mount the range finder on the selector assembly (fig. 170).

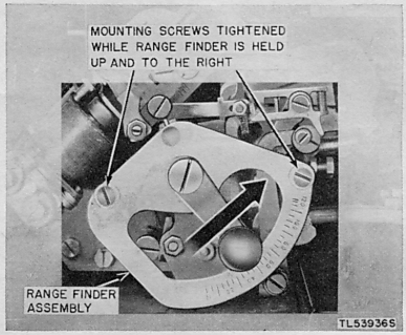


Figure 170. Replacing range finder.

(2) Remove the bell crank screw and remove the bell crank (fig. 171). Remove the trip-latch screw, and the trip latch and spring. Remove the stop-lever screw locknut and the stop-lever screw. Remove the stop-lever spring and stop lever.

b. Motor-Stop Bracket Assembly. Remove the two motor-stop lever bracket mounting screws. Remove the motor-stop lever bracket assembly (fig. 172).

c. Removal of Selector Mechanism (fig. 171). Set the typing unit so that it rests on its right side. Remove the two screws that hold the rangefinder to the selector assembly and remove the rangefinder. Using a large screw driver, remove the outer selector-cam friction clutch plate (friction disk) (fig. 173) by turning the plate *clockwise*, and remove the selector cam. Remove the two screws on the selector magnets that connect the lines from the selector magnets to the contacts on the bottom of the typing unit. Remove the main-shaft clutch throw-out lever spring. Cut the lacing twine that laces the selector-magnet line to the motor-stop lever bracket. Remove the three screws that mount the selector assembly to the typing unit frame. Carefully remove the selector assembly. It is necessary to separate the **T** levers from the vanes to free the assembly. Also watch the main-shaft clutch throw-out lever; do not let it disengage from its right pivot screw. Handle the selector assembly (fig. 171) carefully so as not to damage any of its parts.

(1) *Removal of selector armature.* The selector armature may be removed either before or after the selector unit has been removed from the typing unit. Loosen the outside selector armature pivot screw locknut, and remove the pivot screw. Remove the selector armature carefully by moving the armature in the direction of the removed pivot screw, until the armature is clear of the opposite pivot screw. Withdraw the armature.

(2) *Removal of selector levers, swords, and T levers.* Remove the selector-lever springs and the locking-lever spring. Remove the five nuts and washers that clamp the separator plates together. Remove the separator plates, the swords, T levers, selector levels, and locking lever.

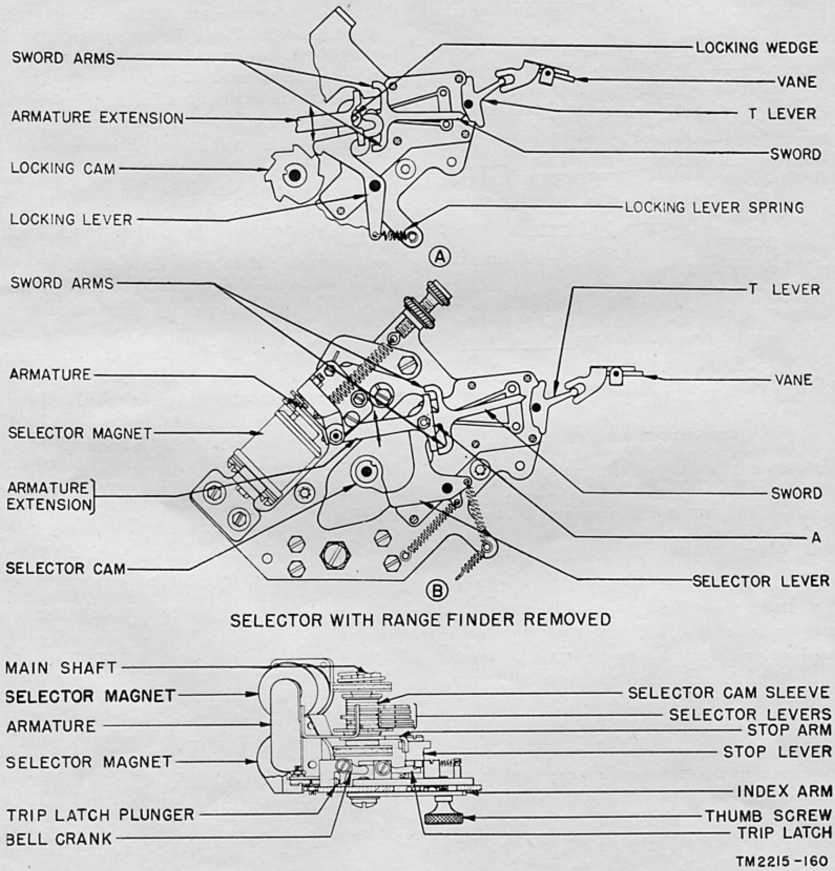


Figure 171. Top of selector unit with rangefinder.

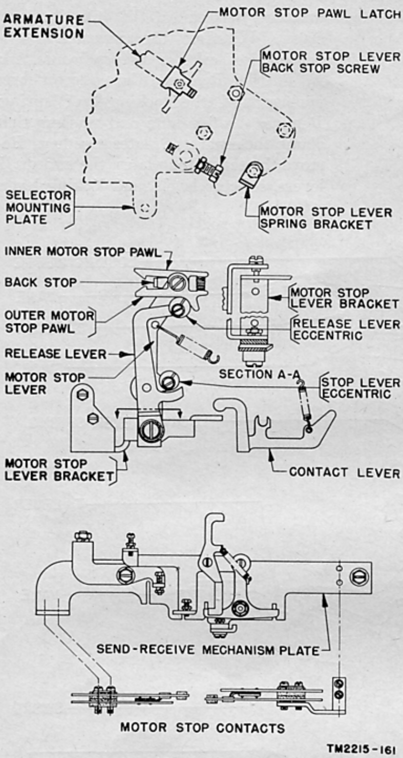


Figure 172. Motor-stop locking assembly.

d. Removal of Main Shaft. The main shaft may be removed independently of other subassemblies or disassembly procedures. Details for removal of the main shaft are contained in paragraph 192.

e. Removal of Printing-Bail Assembly. Do not remove the printing-bail assembly unless it requires repairs. The type-bar carriage must be removed before the printing-bail assembly can be removed. Proceed as follows:

(1) Remove the printing-bail spring and the function-bail spring (fig. 169).

(2) Remove the two nuts and washers that fasten the function-lever bail to the printing bail.

(3) Remove the two screws and lockwashers that fasten the right-hand bail bearing (fig. 169) to the typing unit frame.

(4) Slide the bail assembly to the right until the left end of the bail shaft clears the left bail bearing; then remove the assembly.

f. Removal of Spacing Shaft. Remove the nut and screw that fasten the carriage-return lock bar to the carriage-return bell crank. Remove the two horizontal screws that fasten the upper bearing block to the typing unit frame. Remove the two screws that hold the carriage-return bracket against the typing unit frame. Remove the shaft by moving the shaft upward and out. Remove the carriage-return bracket and the attached parts.

192. Removing and Inspecting Main Shaft

a. General. Most main-shaft parts are replaced rather than repaired. The parts of the main shaft that are between the main bearing locknuts and the nearest shaft end can be replaced without removing the shaft (fig. 174) from the typing unit. If the main shaft must be removed to reach the part that must be serviced or replaced, completely disassemble, clean, inspect, and lubricate the shaft before restoring it to its operating position.

b. Removal of Main Shaft From Typing Unit.

(1) Remove the typing unit from the teletypewriter base. Set the typing unit on a workbench so that it rests on its right side (or end) (fig 173).

(2) Remove the two screws that hold the rangefinder to the selector assembly, and remove the rangefinder.

(3) Remove the outer, selector-cam, friction clutch plate (retaining disk) (fig. 173) by turning the plate *clockwise*, using a large screwdriver for the purpose, and remove the selector cam.

(4) Place the typing unit so that it rests on its back, and remove the four screws that hold the right and left bracket caps in place (fig. 173).

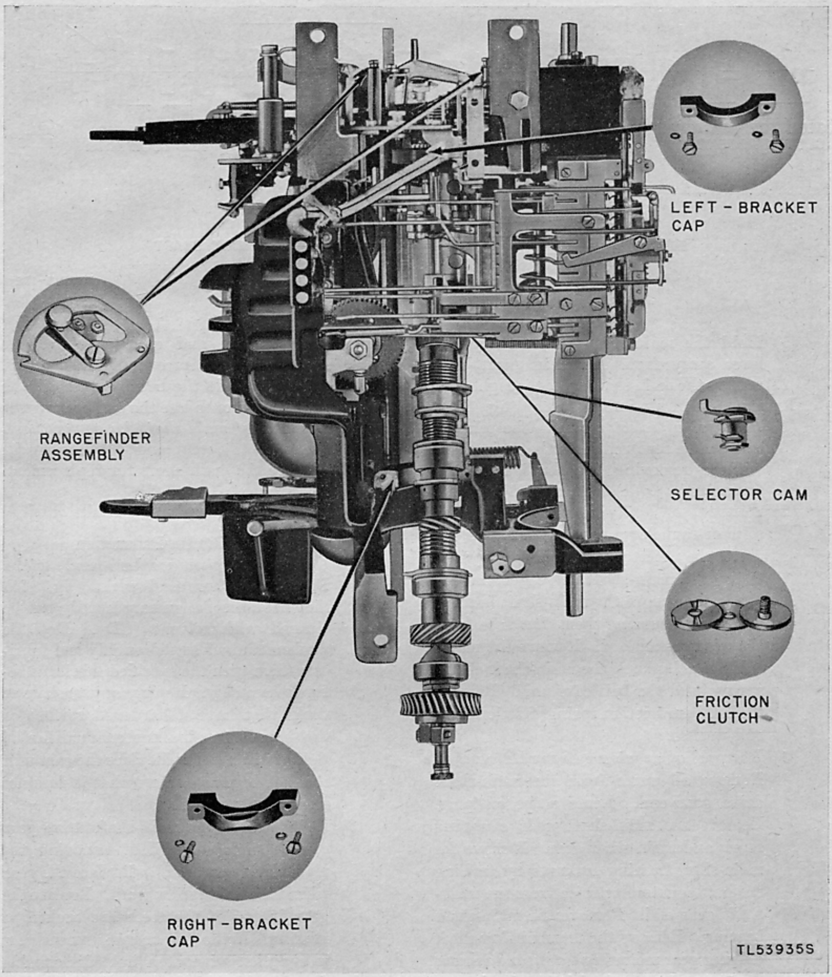


Figure 173. Removal of main shaft from typing unit.

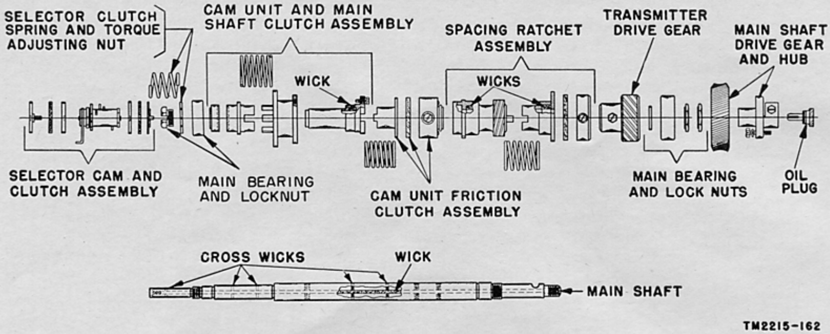


Figure 174. Main-shaft parts in sequence of removal.

(5) Hold the main-shaft clutch throw-out lever away from the main shaft, and remove the main shaft from the right end.

c. Removal of Main-Shaft Parts (fig. 174).

(1) *Removal of selector cam.* The selector cam can be removed from the main shaft without removing the shaft from the typing unit (*b* (1), (2), and (3) above).

(2) *Removal of bail cam unit.* After the selector-cam sleeve has been removed, remove the selector-unit friction spring. Grasp the main-shaft drive gear in one hand and remove the main-shaft bearing locknuts by turning them *clockwise* from the selector-cam end. Remove the main-shaft clutch plates, the main-shaft clutch spring, and the bail cam unit. Remove the bail cam friction spring, friction disk, and washer.

(3) *Removal of spacing escapement ratchet.* Remove all parts from the main-shaft drive gear end. Remove the oil plug. Remove the main-shaft gear clamping screw and main-shaft gear. Remove the main-shaft bearing locknuts by turning the nuts counterclockwise from the main-shaft gear end. Remove the main-shaft bearing. Remove the transmitting-shaft driving gear mounting screw, and remove the gear. Remove the friction clutch, stop sleeve, and clutch spring. Hold the shaft vertical and lift off the spacing-escapement ratchet and gear. Remove the thrust bearing race mounting screw. Carefully slide the bearing race off the shaft so as not to lose the ball bearings.

(4) *Removal of main shaft for replacement.* Steps in (1), (2), and (3) above will prepare the main shaft for replacement.

193. Repairing and Replacing Main Shaft

a. Inspection and Repair Procedure.

(1) *Gummy friction washers and wicks.* Friction washers and wicks (fig. 175) that have become gummy usually can be cleaned with solvent (SD). Dry the washers and wicks thoroughly and lubricate them with the specified lubricant before reassembly. Replace any washers or wicks that have a hardened surface or that have lost their absorbent qualities.

(2) *Selector cam unit.* Replace the cam unit if it has become so worn that it does not meet requirements.

(3) *Drive gear.* The main-shaft drive gear can be replaced without removing the main shaft (par. 192). Replace the gear when it becomes badly worn. Replace the gear if any of the teeth are broken or missing. If the new or replacement gear is supplied without a hub, disassemble the old gear unit by removing the three hub mounting screws and lockwashers, and use the old hub with the new gear.

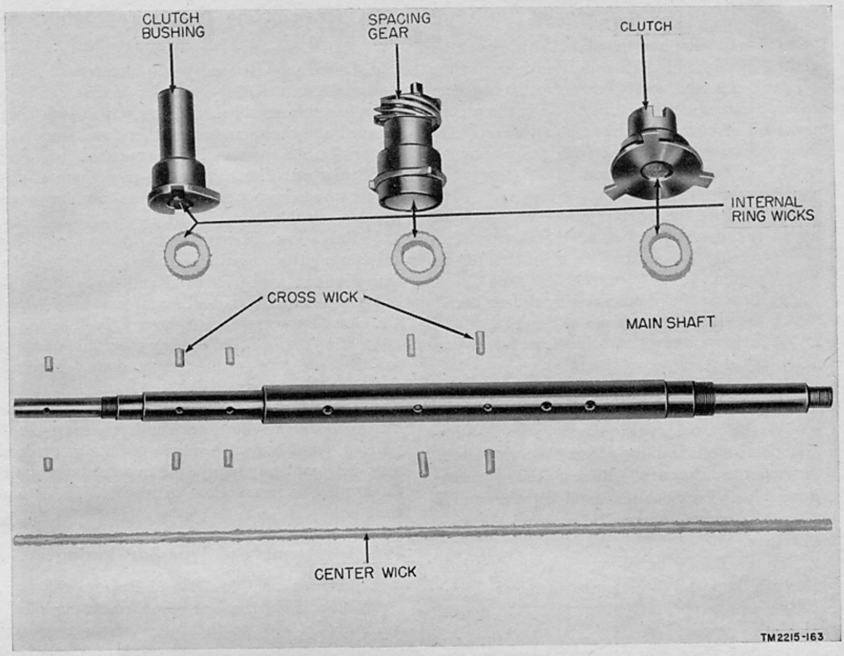


Figure 175. Location of main-shaft oil wicks.

b. Replacing Main Shaft.

(1) Set the typing unit on a workbench so that it rests on its back. The main shaft can be replaced with the selector unit in place, but the rangefinder must be removed as instructed in paragraph 191.

(2) Remove the selector cam and preceding components from the main shaft, if they are not already removed, and slide the main shaft into place from the right side.

(3) Move the clutch throw-out lever until the main shaft will slide past and into normal position.

(4) Place the bearing caps on the main bearings, and tighten the screws just enough to prevent the shaft from shifting. Be careful to place the bearing caps so that the beveled corner is on the same side as that on which the casting is beveled (fig. 173).

(5) Place the selector cam and associated parts on the end of the shaft (fig. 174). Be sure that the friction clutch plates face in the right direction, and that the selector-cam ends fit into the slots of the driven clutch plates. After the driving clutch plate, on the end of the shaft, has been tightened, see if the selector cam can be turned by hand. It should turn without difficulty. Replace the rangefinder as described in paragraph 195*b*.

(6) For complete instructions for the adjustment of the main shaft and rangefinder, which must be completed before the teletypewriter can be operated, refer to section VII of this chapter.

194. Repairing Platen Assembly

a. General. Replace the platen if it cannot be repaired locally and if its condition is such that paper will not feed, or if the surface has become sticky, or if the platen has split. Keep the platen free of oil or cleaning solvent at all times. All repair work should be done with the platen removed from the teletypewriter.

b. Removal of Platen.

(1) Remove the three pilot screws that hold the detent ratchet to the shaft. The ratchet is located at the right side of the platen.

(2) Remove the platen shaft by sliding it and the friction clutch out to the left.

(3) Remove the platen. Be careful not to get dirt, oil, or grease on it.

c. Cleaning Platen. Clean metal parts of the platen with a cloth dampened in solvent (SD). Clean the rubber parts with soap and water. Wipe with a damp cloth and dry with a clean dry cloth.

d. Pressure Rollers. Release the pressure roller springs, back out the shoulder screws, and remove the pressure rollers. *Do not wash the pressure rollers.*

e. Remove Rough or Shiny Surfaces. Place platen in a lathe and cut a new surface by holding No. 0000 sandpaper, supported by a flat block, against the platen surface. Cut away only as much of the surface as is necessary to remove the rough or shiny spots. In the case of smooth platens remove sufficient platen material so that the platen will feed paper. Never attempt to remove deep cuts or breaks in the platen by the sanding method.

f. Reassembly of Platen. Restore the platen to its operating position in the teletypewriter by following the disassembly procedure in *b* above, in a reverse sequence. See that the platen is inserted in its proper position before inserting the pilot screws. Using a flashlight, or other small light, look down a pilot screw hole of the platen detent ratchet, while turning the shaft. Stop turning when an indentation in the shaft can be seen. Insert a pilot screw and tighten it. Move the shaft to determine whether the pilot screw is centered, and retighten the screw. Repeat the process until the screw will no longer turn. Insert and tighten the other two pilot screws.

195. Reassembling Typing Unit Subassemblies

a. General. Generally all subassemblies are reassembled in the reverse order of that in which they are disassembled. If the parts have been cleaned and the surfaces are, therefore, free from oil, relubricate them as they are reassembled. Pay particular attention to all parts or mechanical elements which are not easily reached once they have been reassembled.

b. Replacing Rangefinder Assembly. By positioning the rangefinder as described below, the rangefinder may be removed and replaced without readjusting the trip-off eccentric screw. After the mounting screws are tightened, back them off at least ½ turn. Take up any resultant play by exerting pressure to the right and up. Tighten the mounting screws.

c. Adjustments. Adjustments that have been disturbed during the disassembling, cleaning, repairing, replacement, or reassembling process must be completely readjusted in accordance with the applicable instructions in section VII of this chapter.

196. Disassembly of Type-Bar Carriage

a. Removal of Code Bars. Remove the two screws that hold the bell crank mounting plate bracket (fig. 176) to the frame of the type-bar carriage and remove the bell crank bracket. Remove the four nuts and washers from the two studs that secure the code bars to the carriage frame. Holding the code bars together, slide the bars and spacer washers out from the studs. Be careful not to lose washers or shims that may adhere to the outside of the code bars and fall off as the code bars are lifted.

b. Removal of Pull Bars and Type Bars (fig. 177). Remove the two fulcrum rod pilot screws. Slide the fulcrum rod out endwise. Remove the type bars. Remove the pull-bar springs and pull bars.

c. Removal of Pull-Bar Bail Plunger (fig. 178). Remove the bell crank mounting plate bracket. Remove the two screws that secure the pull-bar guide (fig. 176) to the carriage frame, and remove the pull-bar guide. Remove the bail guide screws and remove the bail guides. Remove the two screws that hold the roller bracket and remove the roller bracket. Remove the two

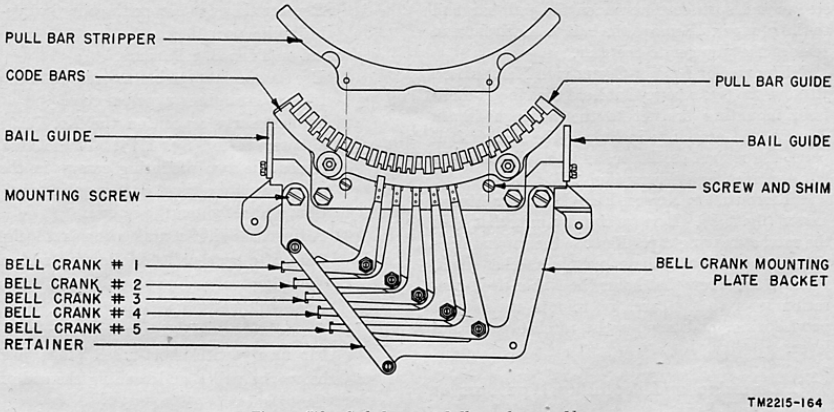


Figure 176. Code-bar and bell crank assembly.

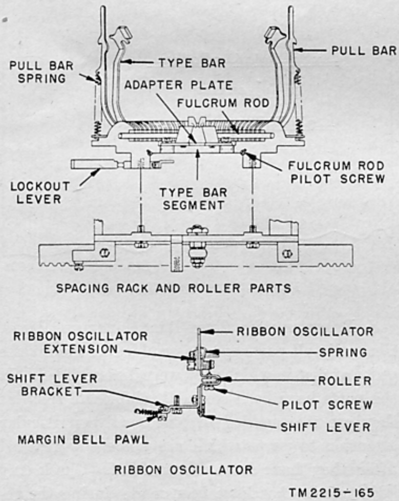


Figure 177. Upper carriage mechanism.

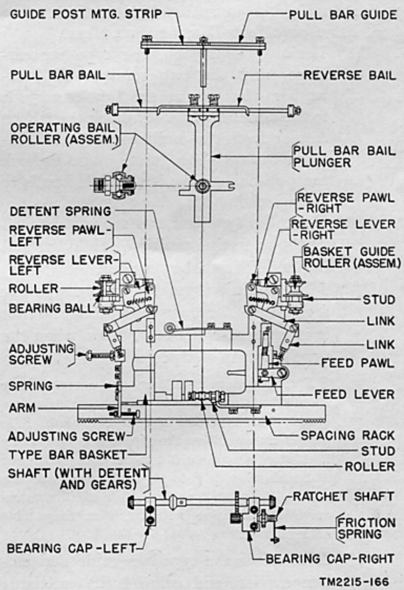


Figure 178. Lower carriage mechanism.

screws and springs that fasten the pull-bar bail to the plunger. Remove the bail to the front and remove the plunger to the rear.

d. Removal of Ribbon-Oscillator Mechanism. Remove the two screws that hold the ribbon-oscillator mounting bracket to the carriage frame. Remove the assembly including the margin-bell pawl, the ribbon oscillator, and the ribbon-oscillator springs and levers (fig. 177).

e. Removal of Ribbon-Feed Ratchet Mechanism (fig. 178). Remove the two nuts that hold the ratchet bearing cap. Remove the ratchet friction spring screw, and remove the ratchet shaft. Remove the screw that holds the ribbon-feed operating lever to the carriage, remove the ratchet pawl spring, and remove the ratchet pawl and lever.

197. Repairing and Replacing Type Bars or Pull Bars

a. General. The decision to repair or replace faulty type bars should be made in accordance with authorized organizational instructions.

b. Replacing Type Bars or Pull Bars.

(1) Remove the ribbon, the type-bar carriage, and the two screws and lockwashers that secure the type-bar guide to the adapter plate. Unhook the ribbon carrier from the oscillator lever and remove the type-bar guide. Also unhook the pull-bar spring if the pull bar is to be replaced.

(2) Raise the type bar and move it beyond its top operating position. Hold the pull bar and lift out the type bar.

(3) Place the new type bar in the type-bar segment, and engage the pull bar so that it is even with the other bars, when the type bar is in rest position.

Note. If new type bars are oversize they should be stoned down with a carborundum stone. The type bar should not bind. Side play clearance, when the type bar is against its back stop, should be not more than .003 inch; .002 inch when it is in its typing position. Be sure to clean the type bar, after stoning, to remove all abrasive material that may have adhered to it.

(4) Reassemble the type-bar guide and ribbon carrier, and connect the oscillator lever to the ribbon carrier.

(5) Replace the type-bar carriage in the typing unit (par. 166).

c. Repair of Type-Bar Pallets.

(1) Use the special type-bar toe straightening tools to straighten type-bar toes.

(2) If necessary, reposition the No. 74294 adapter plate (fig. 177). To do this, loosen the two mounting screws in the adapter plate, adjust to the required position, and retighten the screws.

(3) Adjust the horizontal alinement (fig. 179) of a type pallet by heating with a soldering tool and moving the pallet thus loosened by tapping it up or down.

(4) Straighten a pallet by gripping the type bar firmly with short-nosed pliers just below the pallet, and bending the end of the type bar.

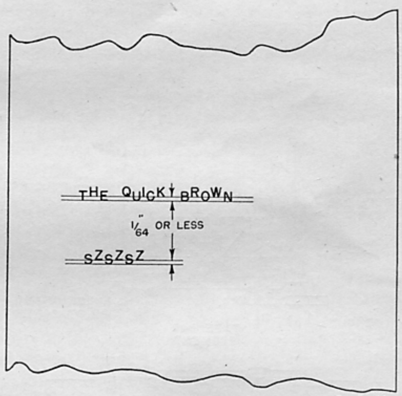


Figure 179. Type alinement.

d. Reassembling Type-Bar Carriage Parts. Generally all parts are reassembled in the reverse order of that in which they were disassembled. If the parts have been cleaned, relubricate them as they are reassembled in place. Give particular attention to parts which are not easily reached after they have been reassembled. Check any adjustments that have been made during the repair or maintenance work.

198. Base Repairs

a. General. After the keyboard, typing unit, and motor unit are removed from the base, the base can be lifted off the table for adjustment or repairs that may be found necessary. The base is not secured to the top of the table but lies on a protective pad. If necessary to thoroughly inspect or service the undersurface of the base, remove the steel plate from the bottom.

b. Mechanical Repairs. Repairs to the base will be governed by the extent of damage or breakage found. Normally the base will require little more than preventive maintenance; however, all mounting screws and similar fastenings should be examined and replaced if necessary. The electromechanical devices such as the relay and fusetron mountings, terminal boards, line jack, and similar contacts should be examined and adjusted in accordance with instructions contained in section VII of this chapter.

c. Electrical Repairs. Repairs or replacement of electrical devices should be accomplished promptly. All wiring should be examined, taped, or replaced as soon as possible. Clean and adjust the electrical contacts associated with the line jack and relay as directed in section VII of this chapter, and as applicable in portions of TM 11–4302. Inspect, clean, the adjust the slip contacts and replace them if they are broken or too badly bent to be restored to normal condition.

d. Weatherproofing and Lubrication. Examine closely the weatherproofing protective coating of the wire associated with the base. Similarly, inspect carefully for rust or corrosion. When necessary renew the protective coating and clean away all old grease or oil, replacing it with clean lubricant as directed in paragraph 43.

199. Table

Repairs or adjustment of the table will normally be confined to replacing electrical or mechanical parts that have become damaged or unusable. Most of the items requiring attention are listed in the preventive maintenance section of this manual. Electrical continuity checks of the various signal and power circuits of the table (electrical service assembly) will usually reveal when wiring should be replaced or repaired. Similarly, examination of the line and power terminal devices will determine when these should be repaired or replaced. Replace the pad on the top of the table if required. Finally, examine the table for broken metal or missing screws, and repair as necessary, prior to painting or refinishing. Apply weatherproofing coating to wiring and other surfaces as directed in paragraphs 44 and 45.

200. Repair of Rectifier Power Unit

Caution: Disconnect all power to the power unit, remove it from the front shelf of the teletypewriter, and set it upon a workbench to repair it.

a. General. Repair of the rectifier power unit will normally include performance of all preventive maintenance procedures described in chapter 3. In addition, such repair will include service and adjustment of the cover, tightening of the terminals, and replacement of fuses, resistors, or selenium rectifying assembly, and capacitors if required. Replacement of major circuit components such as the choke coils, rectifying assembly, transformers, etc., should include replacement of worn wiring, defective mounting screws and brackets, and careful adjustment that may be necessary to prevent future troubles in the unit.

b. Mechanical. When broken or damaged parts are revealed during inspection, replace such parts. Be careful to use lockwashers and insulating washers wherever they were originally used. Replace cracked or broken terminal panels if possible. When any circuit component is removed, always tag, or otherwise identify, the conductors and the terminals from which it was removed, so that replacement can be made easily and without confusion. If the color code of the various wires and conductors is still recognizable, note the color code in order to identify the connection. If the color has faded or the insulation is worn, replace the wiring. Replace wiring where the rubber insulating material has become hard and brittle.

c. Electrical. With a voltohmmeter (or other suitable continuity meter), and using the schematic diagrams as a guide, test the various circuits to locate trouble. When the trouble has been located, refer to the actual wiring diagram of the rectifier power unit (fig. 153) to locate the circuit component that requires replacement.

d. Adjustments. Be sure that no power is applied to the rectifier power unit during the following adjustments.

(1) *To adjust for a-c input voltage.* Connect the flexible lead on the left-hand side of the panel (behind hinged cover) to the terminal with the marking which most nearly corresponds to the voltage of the available a-c supply.

(2) *To adjust for frequency.* Connect the two flexible leads on the right-hand side of the control panel to the two terminals having markings which most nearly correspond to the frequency of the available a-c supply.

(3) *To adjust d-c output for 120 volts.* Connect a 600-ohm resistor in series with a suitable milliammeter across the d-c output of the rectifier, and connect the flexible leads located near the top of the control panel to the terminals (marked L, M, H, and 1, 2, 3, 4, 5) which cause the milliammeter to register a current flow which is nearest to but not less than .2 ampere (200 ma). Refer to paragraph 18 for equipment connections and to section VII of this chapter for further details of requirements and adjustments.

Note. Check this adjustment when the rectifier is installed and periodically thereafter. Voltage drop due to initial aging of the rectifying assembly decreases with service. After the first few months of use, the rectifier should operate for long periods of time without the necessity for readjustment. If, at any time, it becomes necessary to use the maximum regulation tap to obtain the proper output current, withdraw the rectifier from service and repair it.

(4) *To check for rectifier operation.* If the rectifier fails to operate, check fuses, a-c supply, adjustments (par. 428), connections, transformer (continuity of windings and voltage output if necessary), resistors, capacitors (par. 146*c*, or use special measuring and testing instruments if available), and choke coil. If the stack output is too low, replace the entire stack assembly.

201. Repainting and Refinishing

a. When a touch-up job is required on the painted surfaces of the teletypewriter, apply the paint with a small brush. When extensive damage to a painted surface warrants complete repainting of the item, do the work where there is no possibility of damaging any of the mechanisms of the teletypewriter.

b. First, clean the surface to be painted. Use solvent (SD) to soften and sandpaper to clean rust spots and metal surfaces that are corroded. Do not use steel wool. Minute particles of steel wool frequently adhere to inner surfaces and enter the internal mechanism of the equipment causing shorts or grounds of electrical circuits.

c. Use only the type of paint authorized by existing regulations.

d. Refer to paragraph 45 for weatherproofing instructions after repairs.

202. Emergency Repairs

a. GENERAL. Under *emergency conditions* normal requirements for new replacement parts may be set aside and any available parts, assemblies, or units used to restore service. *Only upon proper authority* use locally constructed, temporarily repaired parts, and nonstandard items or adjustments, to restore service. Replace or readjust them at the earliest opportunity.

b. REPAIRS TO CASTINGS. Frames of cast-iron or steel may sometimes be repaired by brazing. Figures 180 and 181 show breaks repaired by this method. Be careful when setting up broken castings for brazing, especially when small errors in positioning cannot be corrected by adjustment.

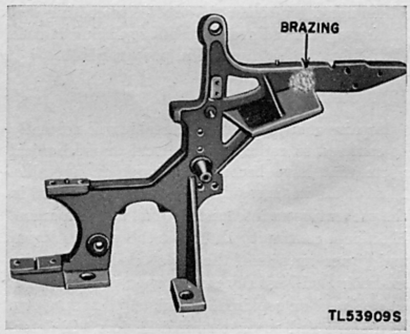


Figure 180. Repair by brazing (side frame).

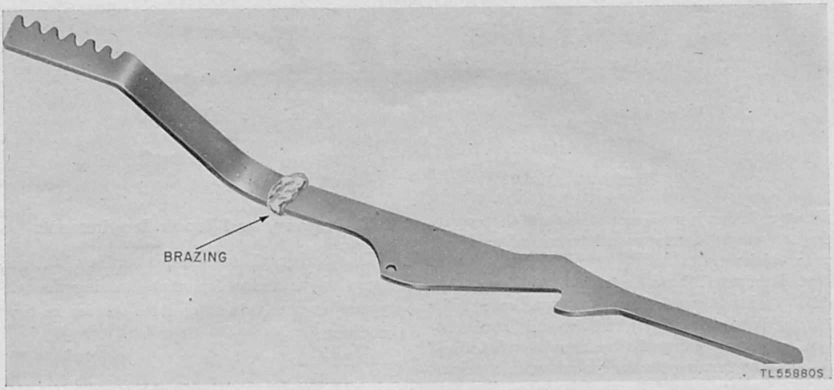


Figure 181. Repair by brazing (pull bar).

c. Stripped Threads.

(1) When threads in the parts have been stripped they can sometimes be repaired by using the next larger sized tap that has the same number of threads per inch, and by using the next larger sized screw. For example, a No. 6–32 thread that has been stripped can be retapped to take a No. 8–32 screw, and the larger sized screw can be used to complete the repair.

(2) When the above method cannot be used, necessary repairs may sometimes be made by drilling a clearance hole for the screw, soldering a steel hexagonal nut over the hole on the side away from the screw, and using a screw of appropriate size and thread (fig. 182).

d. Repairs By Soldering. Solder may be used in joining any metals that can be tinned. Such metals are copper, brass, or steel. The repairs must be made in such a way that there will be little strain on the solder. Figure 183 shows a repair to a steel bar with the use of solder and a piece of metal bent to a **U**-shaped section to take the mechanical strain. Both the sheet metal (out of which the **U** section was formed) and the repaired part must be tinned by using an acid flux. In the above example, a large area of solder holds each side of the broken part of the sheet metal **U**; the sheet metal brace gives the joint strength.

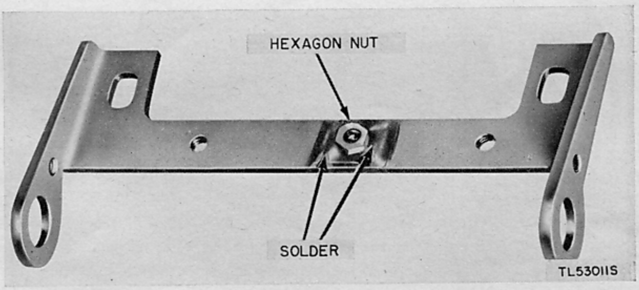


Figure 182. Repair of threads.

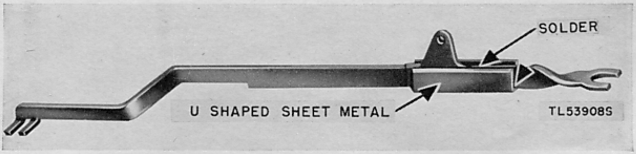


Figure 183. Repair by soldering.

When acid flux is used, clean the parts thoroughly in hot water to remove all traces of acid left after soldering.

e. Tempered Metal Parts.

(1) Parts, such as small springs that may be broken near one of their ends, can sometimes be reused after a new loop is formed by turning the broken end with a pair of pliers.

(2) Large springs and tools that are broken near the ends can sometimes be heated and bent into shape. Figure 184 shows a spring, the end of which has been repaired by heating and reshaping. Certain tools can be heated, reformed, hardened, tempered, and resharpened to restore their usefulness.

203. Recovery and Repair Requirements

This paragraph describes examples of the necessary requirements for reconditioning the teletypewriter and returning it to service in good condition.

a. General.

(1) Nonferrous (not iron) metal parts may be tarnished (surface discoloration) unless otherwise specified.

(2) Steel springs rusted beyond the stage of surface discoloration shall be replaced.

(3) Bearings with pits or discoloration that cannot be removed with cleaning solvent (SD) shall be replaced.

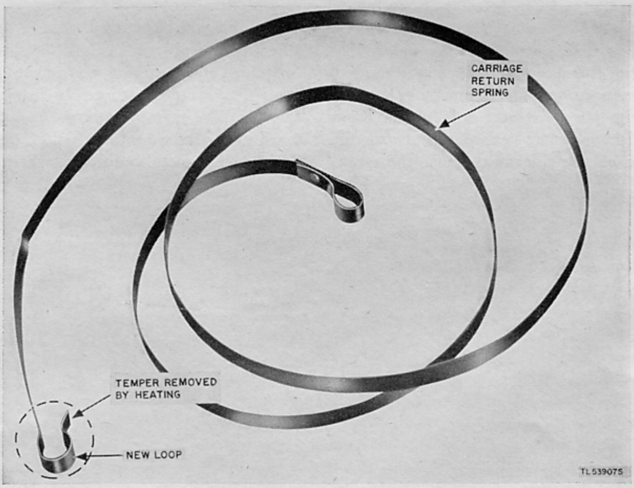


Figure 184. Repair of metal spring.

(4) All interior surfaces must be free of loose dirt, lint, chips, flaky rust, corrosion (formation of salts), dirty oil, etc.

Note. Refer to paragraph 163 for cleaning in-instructions and to paragraph 201 for retouching and refinishing.

(5) When adjustment requirements cannot be met, replace affecting parts.

b. Mechanical Features.

(1) Screws and nuts shall not be stripped and, except those used for adjusting purposes, shall be tightly set. Adjusting screws equipped with locknuts shall be tightly held in place by locknuts.

(2) Screwhead slots must not be so burred as to interfere with engagement and turning with a screw driver. Nuts and heads of bolts may be slightly burred provided they can be properly engaged and turned with an open-ended or socket wrench.

(3) All parts shall be free from slivers, splinters, sharp burrs, sharp edges, etc., which might cause personal injury.

(4) Lockwashers removed in course of repair operations shall be replaced if locking edges are rounded.

(5) If parts have been loosened or readjusted, contact points shall fall wholly within the circumference of the opposing contact, except where contacts have the same diameter. In this case, contact centers shall not be appreciably out of alinement (not out of alinement more than 25 percent of their diameter).

c. Electrical Features.

(1) Insulation on wiring shall not be worn, loose, or frayed. Varnished cambric tubing shall not be torn. Defective wires may be replaced with No. 18 art silk-covered, single-conductor Deltabeston fixture wire of same color sewed into cable. Slightly worn insulation must at least be repaired with friction tape or shellac varnish.

(2) Cables shall be located so as not to interfere with moving parts.

(3) Insulation between insulated metal parts and between metal parts and wiring shall be capable of withstanding a standard, a-c insulation break-down test of 500 volts a-c (frequency 15 to 65 cycles) for at least 1/4 second.

(4) Coils, capacitors, and resistors shall show no signs of being burned, overheated, or otherwise damaged.

(5) Capacitors with cracked compound and those showing indications that the compound flowed out of the can, capacitor cans, and coil coverings which are torn shall be considered damaged and shall be discarded.

d. Marking. The serial number should be sufficiently legible to be identified under ordinary lighting conditions. If the serial number is missing or not legible, it may be possible to obtain the correct number from the records. If not, make arrangements to assign a substitute number for identification purposes.

e. Typing Unit (pars. 190 through 197).

(1) Castings shall not be cracked or broken. If the platen unit casting is cracked or broken, replace the casting. If any other casting is broken, replace the typing unit, then repair the defective unit by replacing the broken casting and making all necessary adjustments.

(2) Main and spacing shafts shall be free of bind, and shall have no broken springs, hard or glazed felt washers, worn gears, bearings, or clutch parts, the replacement of which would require removal of the shafts.

(3) Spacing and escapement pawls shall not be worn over 0.010 inch at point of engagement with the main-shaft spacing ratchet. Judge by eye. Replace or repair the typing units not conforming with the above.

(4) Friction clutch felt washers, which are hard or glazed or which are removed, and felt lubricating wicks, which are removed in course of repair, shall be replaced by new washers or wicks and thoroughly saturated with oil.

(5) Printing- and function-bail shaft bearings shall not have radial play over 0.015 inch when the printing- and function-bail springs are unhooked and the printing-bail roller is on the lower part of its cam. Judge by eye and feel. Re-

place or repair the typing units not conforming.

(6) Printing- and function-bail roller assemblies shall not have radial play exceeding 0.015 inch when the printing- and function-bail springs are unhooked and the rollers are on the lower part of their cams. Judge by eye. Replace worn roller assemblies.

(7) Function-bail blade and the associated push bar and reset bar latching edges shall not be worn more than 0.010 inch deep at the points of engagement. Judge by eye.

(8) Printing-bail blades, carriage tracks, and platen slide bars shall not have worn spots greater than 0.010 inch deep. Judge by eye and feel. Printing-bail blades may be reversed in order to present an unworn surface to the type carriage plunger roller.

(9) Function-lever roller shall rotate freely and shall not have more than easily perceptible radial and end play of 0.008 inch and 0.015 inch, respectively, when not in contact with the function levers. Replace worn parts.

(10) Type-bar backstop shall not be worn more than halfway through the leather. Replace nonconforming *leather* strips.

(11) Type pallets may be replaced or moved on type bars by first heating solder. Pallets shall be soldered in position with nonacid flux.

(12) Carriage draw strap shall not be frayed. Replace worn straps.

(13) The platen surface shall be smooth and neither cracked, swollen, worn, nor pitted by type. Rubber shall be tight on metal core. Platens may be smoothed after removal from the typing unit by rubbing with No. 0000 or finer sandpaper placed around the platen. Replace platen if rubber is loose, cracked, swollen, or worn.

(14) Selector-cam sleeve shall not have more than just barely perceptible radial play with retaining disk removed and spring tension released. Replace selector-cam sleeve if loose or if any affected adjustments cannot be met. If still loose, replace main shaft.

(15) The locking lever shall not be obviously worn at point of contact with its cam on the selector-cam sleeve. Replace worn locking levers.

(16) Locking lever and locking wedge shall not have more than just barely perceptible wear of 0.005 inch at points where they engage each other.

(17) Armature extensions shall be free of grooves at points of engagement with swords. Replace if worn.

(18) There shall be no obvious wear in the following parts: clutch teeth, throw-out lever, selecting vanes, bell cranks, code bars, T-levers, pull-bars, range-finder mechanism (no perceptible wear permitted in trip latch or stop lever), and all rollers. Replace worn parts and adjust.

(19) The stop nut and screwhead of the pull magnet selector shall not show a worn ridge at the point of engagement with the armature. Replace if worn.

(20) Selector armature. Radial play in the armature bearing shall not be more than barely perceptible when the end play has been adjusted to the minimum perceptible. Replace worn armature or pivot screws or both.

(21) Selector swords and lever posts shall be equipped with a nut and lockwasher on the under side of the selector mounting plate.

(22) The paper insulator No. 74946 (fig. 185) shall be between the terminal board and the crossbar.

(23) New black ribbons shall be supplied with repaired typing units.

(24) The main shaft drive gear and other fiber gears shall not be obviously worn or have any broken teeth.

f. KEYBOARD (pars. 184 through 189).

(1) Keytop characters shall be clean and easily distinguishable under average lighting conditions.

(2) Transmitter contacts shall not be appreciably worn (at least 0.025 inch thick) and shall have no build-ups or pits or broken springs. Judge by eye.

(*a*) Contacts may be filed flat with contact file No. 91117 and then burnished with burnisher No. 88993.

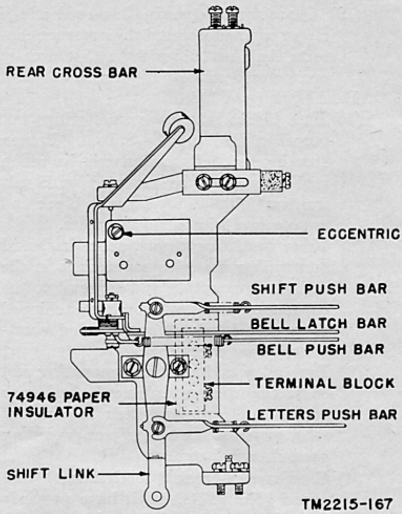


Figure 185. Typing unit contacts and rear crossbar parts.

(*b*) Insulator adjacent to contact springs shall be cleaned free of metal filings and dirt.

(3) Cam sleeve end (bushing or not) shall project beyond the front end of the cam at least $\frac{5}{32}$ inch or 0.156 inch so that the contact levers are approximately centered on their respective cams.

(4) If requirements are not met, replace cam sleeve assembly and oil wicks. Place oil wick in the rear shaft bearing so that it projects into the bearing (approximately $\frac{1}{16}$ inch), and place felt button No. 90438 in the closed end of front shaft bearing oiler No. 7383.

(5) Transmitter shaft shall not be scored or appreciably worn.

(6) Transmitter shaft driving gear shall not be obviously worn or have any chipped teeth.

g. Motor Unit (pars. 166 through 183).

(1) Motor bearings shall turn freely and shall not contain any grit. Bearings which cannot be cleaned or which, after cleaning, are coated with a yellowish varnishlike substance shall be replaced. Refer to paragraph 168*a* before removing bearings.

Note. Bearings may be flushed with high grade kerosene, mineral spirits, or noncorrosive cleaning fluid, if all the cleaning fluid is removed from the bearings and the bearings are packed with grease before they are reassembled on the shaft.

(2) Motors shall be equipped with ball oilers in good condition on each bearing. Normally, grease will be applied to the ball bearings through the ball oilers when it is not necessary to dismantle the motor.

(3) Surfaces of commutators and governor contact disks shall be free from burns, scores, pits, or other deformation of surface or structure, except slight scoring caused by normal wear. Commutators shall have no high, low, or loose segments or flat spots.

Note. A bronze-color glaze on the surface is very desirable and should not be mistaken for a burned surface.

(*a*) Slight defects may be removed by sanding the surface with No. 0000 or finer sandpaper. Deep grooves may be removed by machining, provided bearings are removed from rotor shaft and the operator is careful to remove all chips from space between commutator segments before reassembling bearings on shaft.

(*b*) It is not necessary to undercut the mica separators on commutators which have been smoothed by machining if the clearance between the commutator surface and the mica is not less than $\frac{1}{64}$ inch. If this clearance does not exist, undercut the mica as described in paragraph 171.

(4) Governor contacts shall meet the following requirements:

(*a*) Contact surfaces shall be bright and smooth and be equivalent to those on new contacts.

(*b*) Contact surfaces shall be flat and free from pits.

(*c*) Contact surfaces shall be parallel to the under side of the contact screwhead.

(*d*) Contacts shall not be perceptibly worn (not less than 0.015 inch thick).

(*e*) Tungsten-*pointed* contact screws (old style) shall be clean and threads shall not be damaged. If a contact point is replaced, the new contact shall be screwed into the contact arm and soft solder applied to the threaded end; use nonacid flux. Later style contacts lack screw threads and are to be soldered to the contact spring (par. 178).

(5) Motor brushes shall be free to move in holders without excessive play; they shall be at least 5/8-inch long exclusive of spring. Brush ends shall be so shaped that at least one-third of their area, and 75 percent of their length is bearing on the commutator. The flexible shunt wire shall not be broken, kinked, or loose in the brush.

(6) Carbon governor brushes on the center contacting governors shall be at least 1/8-inch long.

(7) Target illuminating assemblies, which require repair or replacement other than replacement of the lamp, should be removed and the wires to the lamp separately taped, if it is necessary to wait for replacement parts.

(8) Governor-adjusting wheel leather rim shall project beyond its metal washers at least 1/32 inch.

(9) Shims (No. 91617) shall be added on the rotor shaft between the governor and the end frame of the motor so that the governor-adjusting wheel clears the wearing strip appreciably when the adjusting lever is in its normal position, and the governor is pushed against the tension of the motor end play spring as far as possible.

(10) Insulation on wiring shall not be worn, loose, or frayed. Insulation may be repaired with friction tape or shellac varnish. Defective wire may be replaced with black No. 18 art silk-covered, single-conductor, Deltabestron fixture wire.

(11) Motor control cable (No. 74789) shall be fastened with lock stitch cord to the rear crossbar casting behind the right end of the clutch throw-out lever bracket.

(12) Character of sparking observed at the motor commutator and the governor contacts shall not differ from that usually encountered on new apparatus.

h. Base Unit (par. 198).

(1) Fuse blocks may have small chips but porcelain shall not be broken. Broken fuse blocks shall be replaced, in which case they shall be mounted with felt washers (No. 90752) between block and casting and without lockwashers.

(2) Fiber insulating sheets, above keyboard and typing unit slip connections in the resistance mounting and adjacent to the capacitors, shall not be broken or chipped to permit insulated parts being short-circuited on each other.

(3) Line relay and resistance mounting and contacting springs shall not be broken or bent so as to prevent their holding the relay or resistance securely or providing good electrical contact.

(4) Send-receive-break mechanism wire guard (No. 74744) shall have properly shaped, long, vertical flange high enough to protect the wiring to the upper terminals.

i. Line Relay.

(1) Line relay contacts shall not be worn, rough, or pitted; the winding shall show no evidence of being burned, overheated, or otherwise damaged.

(*a*) Replace line relays not conforming with the above.

(*b*) If only the contacts are defective, the armature with contacts and antichatter springs may be replaced.

(*c*) Clean or replace line jack contacts as required.

j. Covers.

(1) Cover doors shall operate freely and their detent knobs shall engage the detent springs so as to hold the door firmly.

(2) Small door openings, insides of covers, and cover plates shall be equipped with lacing. Door lacing shall not be frayed. If lacing is frayed, replace with No. 88877 black lacing.

(3) Cover windows shall be clamped firmly in covers and shall not be cracked or chipped on the tearing edges so as to ex-

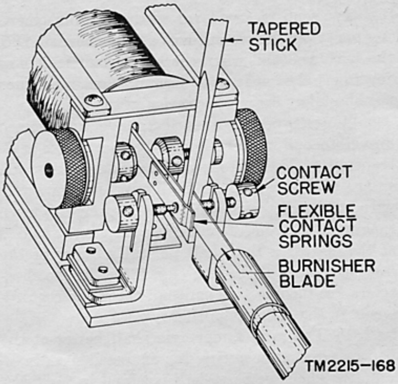


Figure 186. Burnishing line relay contacts.

pose any sharp edges which might cause personal injury. Glue $\frac{3}{32}$-inch felt to the inside surface of the ear which forms the lower support for the glass.

(4) Copyholder message line guide shall operate freely and shall not be burred or have sharp edges which might damage the finish. Sharp edges on the under surface of the guide may be removed with very fine abrasive cloth.

(5) Cover pads shall fit snugly against the inside of the cover and may have tears not more than 1 inch long. Tears more than 1 inch long may be repaired by sewing.

k. Table.

(1) The table shall not have broken screws or metal, frayed or broken wiring or insulation.

(2) The one-piece pad and associated metal channels shall be in good condition on top of the table.

l. Rectifier.

(1) The fuses and all contact surfaces shall be clean and in good condition.

(2) The hinged cover must fit and close properly.

(3) The terminals and terminal panels shall not be broken or cracked.

(4) The rectifier shall not have wiring which is cracked, brittle, frayed, broken, or faded beyond point of recognition of color code.

Section VI. FINAL TESTING

204. Tests on Assembled Teletypewriters

For the following tests the teletypewriter must be connected to a suitable power supply. The SEND REC BREAK key must be in SEND position unless otherwise specified.

a. The motor shall start and rotate without excessive sparking at the commutator and governor brushes. The motor position and speed should conform to the description given in paragraphs 208 and 365. Replace the governor contacts if contacts are not bright, smooth, flat, free from pits, and parallel to the under side of the governor contact screwhead.

b. The selector clutch torque shall conform to the requirements outlined in paragraph 375. Teletypewriters, when receiving the appropriate signal, shall meet the following requirements:

(1) The type-bar carriage shall move one character space to the right each time a character or space signal is received, and it shall space repeat to the end of the line when the space signal is received continuously.

(2) The guide screw shall not bind in its groove in the carriage track.

(3) The selector vanes shall be straight.

(4) The spacing mechanism and carriage-return spring adjustments on the typing unit shall conform to those outlined in section VII of this chapter.

(5) The adjustments of the space-repeat mechanism on the keyboard shall conform to those described in section VII of this chapter.

(6) The paper shall feed correctly one or two lines per linefeed operation, depending on the position of the single-double line-feed lever when the LINE FEED signal is received.

(7) The pressure roller release shaft arm shall be in the forward position.

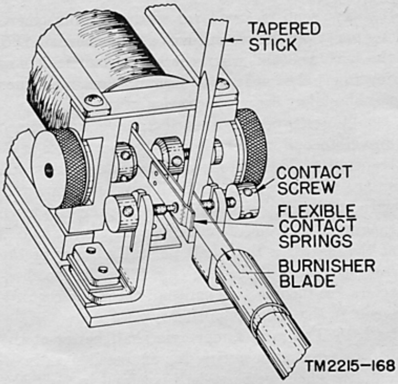


Figure 186. Burnishing line relay contacts.

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(4) Copyholder message line guide shall operate freely and shall not be burred or have sharp edges which might damage the finish. Sharp edges on the under surface of the guide may be removed with very fine abrasive cloth.

(5) Cover pads shall fit snugly against the inside of the cover and may have tears not more than 1 inch long. Tears more than 1 inch long may be repaired by sewing.

k. TABLE.

(1) The table shall not have broken screws or metal, frayed or broken wiring or insulation.

(2) The one-piece pad and associated metal channels shall be in good condition on top of the table.

l. RECTIFIER.

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(2) The hinged cover must fit and close properly.

(3) The terminals and terminal panels shall not be broken or cracked.

(4) The rectifier shall not have wiring which is cracked, brittle, frayed, broken, or faded beyond point of recognition of color code.

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(6) The paper shall feed correctly one or two lines per linefeed operation, depending on the position of the single-double line-feed lever when the LINE FEED signal is received.

(7) The pressure roller release shaft arm shall be in the forward position.

(8) The platen shaft shall be free of bind.

(9) The line-feed function lever shall be free of bind.

(10) The type-bar carriage shall return to the left side of the typing unit from any point of its travel, without bounce, within the time allotted for one carriage-return and one line-feed operation when the CAR RET, LINE FEED, and any character signal is received in turn as rapidly as permitted.

(11) The carriage rollers shall rotate freely without bind.

(12) The carriage-return function lever shall be free of bind.

(13) Carriage-return linkage shall not have more than $\frac{3}{32}$ inch of play measured on the lock bar. Judge by eye.

(14) The platen shall shift and unshift when the FIGS and LTRS signals are received alternately and, unless otherwise specified, when the FIGS signal and the space signal are received alternately.

(15) The platen assembly shall be free of bind.

(16) Shift linkages shall be adjusted as described in section VII of this chapter.

(17) Figures, letters, and space-function levers shall be free of bind.

(18) The unshift-on-space, cut-out lever adjustment shall be checked.

(19) The signal bell shall ring when the platen is in the FIGS position, and the BELL (upper case S) signal is received.

(20) The bell hammer and its operating lever shall be free of bind.

(21) The bell function lever and sixth vane shall be free of bind.

c. Motors shall stop when FIGS and STOP (upper case H) keys are depressed in turn.

(1) The pawls, lever, release lever, and function-contact lever of the motor-stop mechanism shall be free of bind.

(2) Motors previously stopped by the remote motor-control mechanism shall start when the break key of the SEND REC BREAK mechanism is depressed to the BREAK position momentarily, or when the line circuit to the magnet is opened momentarily and then closed.

d. The send-receive lever on the sending-receiving teletypewriters shall move from the SEND to the REC position when the line circuit is opened for a period of at least two blank signals, or when the blank key is operated twice in succession.

e. A teletypewriter shall receive undistorted miscellaneous matter signals from a brush style transmitter distributor such as the test paragraph shown in figure 187. It shall type all characters without error, with uniform impression, even spacing, and even left margin. Excess characters at the end of a line shall partially overtype the last characters of the line (fig. 187). If the characters are incorrect or omitted, check the requirements in the following order:

(1) The rangefinder arm shall be set at the optimum setting for distorted signals.

(2) The type bars shall not bind in the type-bar segment or guide slot.

(3) The pull bars shall be free of bind.

(4) The code bars, bell cranks, selector vanes, T levers, and selector levers shall be free of bind.

(5) The pull-bar bail and operating lever rollers shall turn freely without bind.

(6) The armature extensions of the pull magnet selectors shall be free of grooves at points of engagement with the swords.

(7) The locking wedge shall not be worn more than 0.005 inch, judged by the eye, at points of engagement with the locking lever.

(8) The stop nut shall be tight on the stop screw of the pull magnet selectors, and neither the screwhead nor the nut shall show a worn ridge at the point of engagement with the armature.

f. If the typed copy does not have a uniform impression, check the following requirements in the order in which they are enumerated:

(1) The ribbon shall not be dry or show signs of wear.

(2) The type bars shall not bind in the type-bar segment or in the guide slots.

(3) Pull bars shall be free of bind.

g. If the left margin is uneven, check the adjustments of the left margin adjusting screw, dash pot, and the carriage-return mechanism.

h. If the character spacing is uneven, check the type alinement and spacing mechanism adjustments. If excess characters do not partially over-

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TM2215-169

Figure 187. Test paragraph.

type the last character of a line, check the setting of the right margin adjusting screw.

i. The teletypewriter shall receive and type without error, miscellaneous matter signals, such as the test sentence sent from a brush type transmitter distributor at 60 wpm and distorted in turn with 40 percent marking and spacing bias when the rangefinder arm is at the optimum setting for bias. If the teletypewriter is being adjusted for special 75 wpm speed service, it should be tested on signals sent at 75 wpm speed instead of at 60 wpm speed. If the teletypewriter fails, check the following points in the order in which they are given:

(1) Armature spring tension and magnet bracket adjustments.

(2) Main-shaft clutch throw-out lever adjustments. The main-shaft clutch throw-out lever shall not be obviously worn or have bind or excessive end play.

(3) Selecting vanes, bell cranks, code bars, and T levers shall not bind or be obviously worn.

(4) Armature extension arms shall not be obviously worn at points of engagement with sword arms.

(5) Rangefinder mechanism shall not bind or be obviously worn.

j. The teletypewriter shall receive and type without error miscellaneous matter signals, such as the test paragraph or test sentence, sent from a brush type distributor at 60 wpm speed and distorted in turn with 35 percent marking and spacing end distortion when the rangefinder arm is at the optimum setting for bias. Teletypewriters being adjusted for 75 wpm speed service shall be tested on signal at 75 wpm speed instead of 60 wpm speed. Armature spring tension adjustments shall be at fixed values within the limits specified.

Note. Increasing the spring tension and/or the armature air gap of pull magnet selectors increases the capability of the teletypewriter to receive marking end distorted signals. Decreasing the values of these two adjustments increases the capacity to receive spacing end distorted signals.

k. Signals sent by the keyboard of a sending-receiving teletypewriter shall be such that the upper and lower limits of orientation range are within five points of the upper and lower limits, respectively, of undistorted signals sent by a brush type transmitter distributor adjusted to send at the same speed as the teletypewriter, the range in both cases being measured at a master set. If characters are incorrect or omitted, check the requirements below in the order given. When satisfactory operation is obtained, discontinue these checks.

(1) Keylevers shall move freely in their guide slots and shall rest against their upstop.
(2) Selector bars and rollers shall be free of bind.
(3) Locking levers shall be free of bind.
(4) Contacts shall be properly alined and free of pits and build-ups.

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NEN AND SO FORTH FOR ALL

CHARACTERS OF THE KEYBOARD.

NOTE: ARROWS IN THIS FIGURE
INDICATE CHARACTERS WHICH
REQUIRE CORRECTING AND
DIRECTION IN WHICH THEY
SHOULD BE MOVED.

TM2215-170

Figure 188. Type alinement and corrections.

(5) Transmitting shaft and cam sleeve shall be free of bind.
(6) Clutch teeth shall fully disengage when any key is held depressed.
(7) Adjustment of keyboard shall conform to section VII of this chapter.

205. Adjustment Data

The data in section VII includes all test requirements and adjustments for Teletypewriters TT-5/FG and TT-6/FG. The information is arranged in the sequence normally to be followed when test and adjustment of a complete teletypewriter is undertaken.

Section VII. APPARATUS ADJUSTMENTS

206. Details of Requirements and Procedures

The information is arranged in each of the following paragraphs, under three headings: preparation, requirements, and adjustments.

a. Preparation. Instructions for arranging the unit for testing or adjusting are furnished under this heading.

b. Requirements. Measurements, spring tensions, settings, clearances, etc., that have been found by experience to give the best results are furnished under this heading. Some requirements have a very small working margin or tolerance; others have a relatively large tolerance. Owing to slight differences in various machines of the same model, some teletypewriters function better when clearances are adjusted to the minimum values recommended; other teletypewriters give better results when clearances are adjusted to maximum values. The same is true of spring

tensions, air gaps, etc. Therefore, the specifications given in this manual for clearances, spring tensions, etc., should be applied as necessary to give best results.

c. Adjustments. Each adjustment is described in the text and, in addition is frequently shown in accompanying illustrations. Adjustments vary in type, including the replacing of an old spring with a new one, bending a leaf-type spring with a spring bending tool, cutting and forming new loops on coil springs, repositioning eccentric screws, and inserting shims between certain parts. As a starting point, when making adjustments, set the clearances midway between the minimum and maximum values until it can be determined if more critical adjustment is required.

d. Use of Range Finder. To determine correct clearances and spring tensions for any given teletypewriter, it is suggested that the range finder be used. Before adjustment of each mechanical unit of the teletypewriter, determine the range finder upper and lower scale readings (par. 209). Following adjustment of the components of a unit, again check the range finder upper and lower scale readings. A range of 80 between the upper and lower scale readings indicates that the teletypewriter is in satisfactory operating condition. Maintenance of a range of 80 usually indicates that most of the major components of the unit directly affecting transmission and reception have been properly adjusted.

207. Preparation for Checking and Adjusting

a. General. Teletypewriter adjustments are made on the basis of various units and assemblies. To facilitate checking and adjusting, it is necessary to remove some units and assemblies, or to set up certain functions.

b. Removing and Replacing Assemblies and Units from Associated Components. Refer to disassembly and reassembly instructions given in section V of this chapter.

c. Setting Up Certain Characters or Functions. When instructions specify the setting up of a certain character or function, use the following procedure: Rotate the main shaft until the printing bail is in its extreme rear position. Hold the front edges of the vanes up to correspond to the spacing impulses and the front edges of the vanes down to correspond to the marking impulses of the code combination to be set up (fig. 158). Then rotate the main shaft as directed in the particular adjustment.

d. Spring Tension. Spring tension values given in this manual are derived from requirements made with teletypewriter spring scales. These are calibrated for use in a vertical-pull position; when the scales are used in any other position the reading is an indicated value. To obtain the proper spring tension readings, use the spring scales included in Tool Equipment TE–50 or TE–50–A.

e. Fixed Pivot Points. Fixed pivots are indicated in the illustrations by solid black circles.

f. Shim Precautions. Before proceeding to adjust any part, read the description of the adjustment carefully. After the adjustment is completed, be sure to tighten any screws or nuts which may have been loosened. If a part that is mounted on shims is to be dismantled, note the number of shims used at each of its mounting screws so that the same shim pile-ups can be replaced when the part is remounted.

g. Removing Cover. Be careful when removing or installing the cover to avoid damaging parts in close proximity. As a precaution, raise or lower the cover slowly with a vertical movement.

208. Adjusting Motor Speed
(fig. 58)

Synchronous motors do not require governors because they are constant speed motors. The speed of a governed motor is checked by viewing the target on the motor governor through the vibrating shutters of a speed indicater (tuning fork) provided for this purpose. With the motor running and the target well illuminated, tap the speed indicator lightly to make it vibrate and hold it so that the shutters are close to the eye. If the motor is running at the correct speed, the target will appear stationary. If the motor speed is too fast, the target will appear to be moving in the direction of rotation; and if the speed is too slow, it will appear to be moving in the opposite direction.

Note. There is a possibility of setting the speed incorrectly, due to getting a speed multiple; for example, the speed can be half the desired speed, or two-thirds the speed, or some other multiple, even though the spots appear to be stationery when viewed through the speed

indicator shutters. Keep this in mind if trouble is experienced in the operation of the unit. When increasing or decreasing the motor speed, depress the governor-adjusting lever or the governor-adjusting bracket respectively, momentarily. See figure 84 for the location of parts.

209. Measure Receiving Range (Rangefinder) (fig. 189)

a. Mounted at the left end of the main shaft on the printer unit is the rangefinder assembly which is used for the purpose of orientating the selector to the incoming signals.

b. Before proceeding to measure the receiving range on a unit equipped with a pulling magnet selector, turn the selector armature spring adjusting screw to a position where it will require 6 to 6⅜ ounces to stretch the armature spring to its position length. Then transmit RY (the letters R and Y sent alternately) to the teletypewriter continually while the receiving range is being determined. The range may be taken as follows:

(1) While RY is being received, loosen the index-arm thumbscrew and shift the index arm of the rangefinder toward 0 until errors appear in the copy. Then move the arm back slowly until errors no longer appear; at least 72 characters should be received without error.

(2) This position indicates one limit of the orientation range. Note the position of the index arm on the scale. Determine the opposite end of the receiving range by repeating the foregoing procedure with the index arm near the opposite end of the scale. After the two limits of the receiving range have been found, set the index arm of the range scale midway between these two points. If facilities for transmitting biased test signals to the receiving unit are available, set the index arm at the optimum setting for the reception of biased signals.

c. This paragraph applies only to units equipped with pulling magnet selectors connected directly (no line relay) into a line circuit with biased signals. Turn the armature spring adjusting screw in a clockwise direction until errors appear in the copy. Then, from this point, count the number of turns the adjusting screw can be turned in a counterclockwise direction before errors again appear. Turn the adjusting screw backward (clockwise) half this number of turns to a point midway between the two failing points, or the middle of the armature spring range, and lock the adjusting screw with its locknut. If no errors appear in the copy throughout the entire range of the spring, set the spring tension at 6 to 6⅜ ounces and lock the adjusting screw. Recheck the orientation range after the armature spring range has been determined.

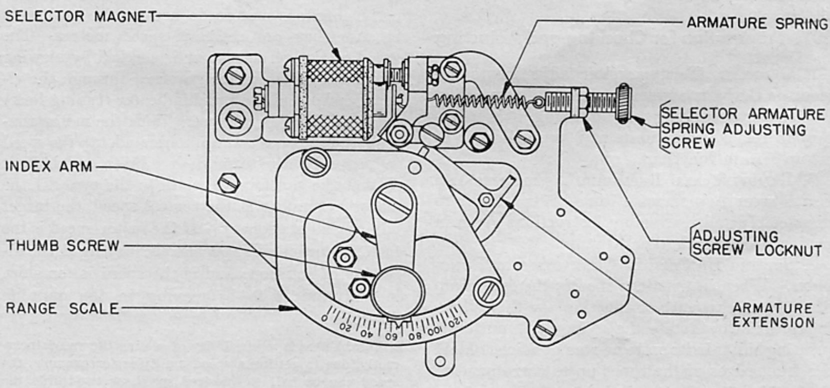


Figure 189. Rangefinder mechanism.

210. Instructions for Mounting Model 15 Teletypewriter Motor, Typing, and Keyboard Units on Base Unit

a. MOTOR UNIT. The motor unit is mounted on the rear right-hand corner of the base by means of three hexagonal headscrews. These screws will be found in place on the base. Attach the motor pinion to the motor shaft by using the screw and lockwasher in place on the shaft. The steel motor pinion and its associated main-shaft fiber gear are shipped as a set of gears in a separate container. Remove the three motor unit mounting screws from the base and slide the motor unit in against the spring contacts. Holding it in this position, thread the three mounting screws into the base. Tighten the two front screws and then back them off about 1/4 turn. Do not tighten the rear mounting screw until the typing unit is in place. Loosen the locknut of the rear adjusting screw on the motor plate and run the screw down fully to the plate. Back off the rear mounting screw to permit this.

b. TYPING UNIT. When setting the typing unit on the base unit, be careful not to jam the main-shaft fiber gear against the motor pinion. Before lifting the typing unit, press the carriage-return lock bar and move the carriage to a position approximately 2 inches from its left-hand stop. Lock the carriage in place by operating the dash-pot lever. Be careful that the carriage-return lock bar is not accidentally pressed while the typing unit is being carried.

(1) *Assembling fiber gear to main shaft.* Underneath the typing unit are two hexagonal studs for protecting the typing unit mechanism from damage when the unit is removed from the base. These studs enter clearance holes in the base unit. Rest the typing unit on the left-hand side and assemble the fiber gear to the main shaft as follows: Remove the oil retaining plug from the end of the shaft. Then rotate the main shaft until the gear hub-clamping screw becomes accessible; remove the clamping screw and lockwasher, and slide the gear hub off the shaft. Remove the three screws and lockwashers from the hub and insert them in the fiber gear from the counterbored side. Assemble the gear and hub and tighten the three screws. Make sure that the gear is flush against the hub flange. Then slip the gear hub with the gear on the main shaft with the gear hub toward the outside of the typing unit until the concaved portion in the main shaft permits the gear hub-clamping screw with lockwasher to be inserted and tightened. Replace the oil retaining plug. The typing unit is to be held to the base unit by three thumbscrews. Remove these screws from the base. The exact location of the typing unit on the base unit will be determined by two dowel pins located in the two forward machined surfaces of the base unit. The right-hand dowel pin fits into a hole in the typing unit casting, while the left-hand dowel pin fits into a slot in the casting. When lifting the typing unit, face the front of the unit. With the right hand, take hold of the flat projection on the upper portion of the right-hand side frame. Place the thumb over the left end of the front carriage track. The index finger of the left hand should grip the left-hand casting of the vane frame. Place the three remaining fingers of the left hand under the extreme lower front corner of the left-hand casting. Be careful when lifting and moving so as not to put any part under undue stress which may disturb its adjustment. When setting the typing unit on the base, hold the unit so that when the left-hand side is resting on the base, the main-shaft gear will be just ready to mesh with the motor pinion. Slowly rotate the motor shaft while carefully lowering the right-hand side to secure proper engagement between the main-shaft gear and the motor pinion. Make certain that the typing unit is placed properly on the locating studs of the base.

(2) *Alinement of motor pinion and main-shaft gear* (fig. 190). For teletypewriters equipped with motors having elongated mounting holes, use the following method for alining the motor pinion and main-shaft gear:

(*a*) Facing the front of the base unit, visually check the lateral alinement of the motor pinion and the main-shaft gear to determine whether a vertical centerline through the gear coincides with a vertical line through the center of the hole in the motor pinion. If these lines do not coincide, remove the typing unit from the base unit and loosen the four motor mounting screws. Replace the typing unit on the base unit, and shift the motor to meet the foregoing requirement as nearly as it is possible to determine by eye. Make certain that the edges of the motor base are parallel to the edges of the motor plate. Then remove the typing unit and tighten the four motor mounting screws.

(*b*) Apply a film of grease to the motor pinion.

(*c*) Replace the typing unit and tighten the three typing unit mounting thumbscrews. By means of the rear adjusting screw, adjust the vertical position of the motor pinion to provide a barely perceptible amount of backlash between the motor pinion and the main-shaft gear, at the point where there is the least amount of backlash in one complete revolution of the main shaft.

Caution: Be careful when refining the adjustment of the vertical position of the motor pinion while the motor is running to avoid damaging the main-shaft gear or reducing the speed of the motor as the result of too close a mesh between the gear and the pinion. After electrical connections have been completed, start the motor and carefully readjust the vertical position of the motor pinion, by means of the adjusting screw, until the gear noise is reduced to a minimum. Tighten the three motor plate mounting screws and the adjusting screw locknut. Recheck the backlash between the motor pinion and the main-shaft gear. For teletypewriters equipped with motors without elongated mounting holes, adjust according to subparagraphs (*a*) and (*c*) above. However, the motor mounting holes may not permit accurate gear alinement according to subparagraph (*a*). In this case, adjust the motor to provide the best possible gear alinement.

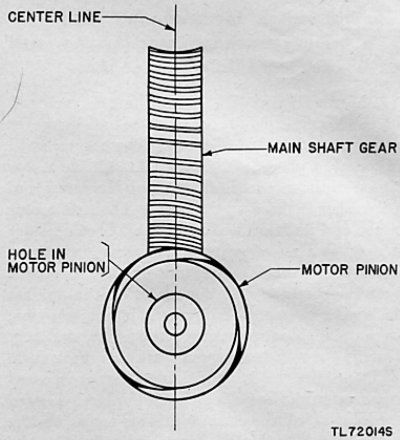


Figure 190. Motor pinion and main-shaft gear alinement.

c. KEYBOARD UNIT. Apply a film of grease to the keyboard gear. When mounting the keyboard unit to the base unit, be very careful not to jam the fiber gear on the keyboard unit against the steel gear with which it meshes on the main shaft of the typing unit. The keyboard unit slides into the opening in front of the base unit upon two rails. The two plates, fastened to the under side of the keyboard unit at the right and left, go under the rails. The keyboard unit is held in place by means of the two thumbscrews located on the keyboard unit. Slide the keyboard unit into place slowly and, at the same time, rotate the motor flywheel back and forth so that the keyboard unit gear will mesh properly with the gear on the typing unit. When the keyboard unit is in place, tighten the two thumbscrews. All teletypewriters are thoroughly lubricated in the factory. However, if the teletypewriters are not installed shortly after they are received, or if any lack of lubrication is apparent, it is advisable to lubricate the machine immediately before installation, in accordance with the lubrication specification. It is suggested that an

extra lubrication be applied to a new machine when it has been in service approximately one-half the normal lubrication interval.

d. Removal of Type-Bar Carriage From Typing Unit. Operate the carriage-return lock bar (fig. 160), and move the carriage to the extreme right. Operate the dash-pot lever, locking the carriage in this position. Hold the carriage-return spring drum so that the spring cannot unwind. Then unhook the drawstrap from the carriage and hook the eyelet of the strap onto the the margin-bell hammer stop post. Move the right margin adjusting screw arm (fig. 207) to the rear. Operate the carriage-return lock bar again and remove the carriage by sliding it off to the right. To replace the type-bar carriage on the typing unit, reverse the instructions given in this paragraph. Do not return the type-bar carriage to its left margin until the right margin adjusting screw arm has been located to its detent spring. Move the right margin adjusting screw arm from its rear position to a vertical position to locate the arm to its detent.

211. Plunger Guide Roller Bracket
(fig. 191)

a. Preparation. Remove the type-bar carriage (par. 210 *d*).

b. Requirements. There shall be not more than 0.010-inch clearance between either the right or left end of the pull-bar bail and the stripper plate when the bail is moved to its extreme forward position. Also the flanged guide roller should be parallel, or within 0.002 inch of being parallel, to the surface of the plunger, and both guide rollers should rotate freely.

c. Adjustments.

(1) To adjust the position of the pull-bar bail with relation to the stripper plate, loosen the plunger guide roller bracket mounting screws and move the bracket to the right or left.

(2) To adjust the flanged roller with relation to the plunger, move the roller end of the bracket up or down with the mounting screws friction tight. Tighten the mounting screws.

212. Plunger Roller Eccentric Mounting Stud
(fig. 191)

a. Preparation. Remove the type-bar carriage (par. 210*d*).

b. Requirements. The amount of play between the pull-bar bail plunger and the rollers should not exceed 0.004 inch. Check for this amount of play throughout the entire travel of the plunger.

c. Adjustment. Adjust the position of the eccentric mounting stud to obtain the desired requirement.

213. Pull-Bar Springs
(fig. 192)

a. Preparation. Remove the type-bar carriage and the type-bar segment assembly as follows:

(1) Remove the type-bar backstop (fig. 196).

(2) Unhook the ribbon carrier from the ribbon-oscillator lever (fig. 202).

(3) Remove the type-bar segment mounting screws.

(4) Hold the pull bars out of engagement with the code-bar mounting plate. (As an aid use a piece of string or wire under the pull bars.)

(5) Slide the assembly forward.

b. Requirements. With any spring unhooked from its pull bar, and an 8-ounce scale hooked in the spring eye, a vertical pull of 2½ to 3½ ounces should be required to pull the spring to its position length.

c. Adjustment. Replace with a new spring.

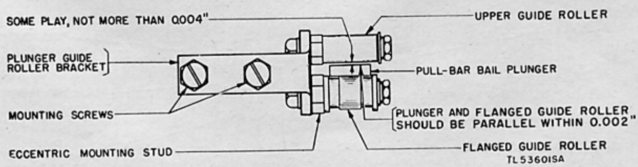


Figure 191. Plunger guide roller bracket.

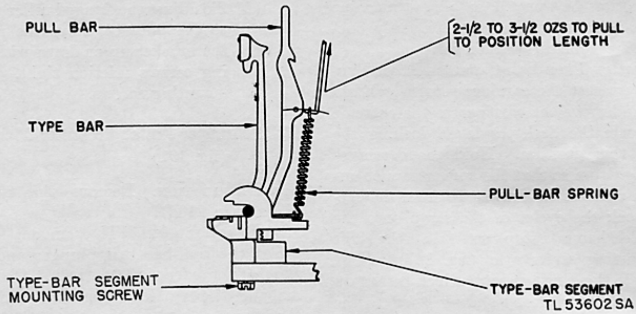


Figure 192. Pull-bar spring.

214. Ribbon-Feed Pawl Spring
(fig. 193)

a. PREPARATION. Remove the type-bar carriage and the type-bar segment assembly (pars. 210*d* and 213).

b. REQUIREMENTS. With the pull-bar bail in its extreme rear position, unhook the ribbon-feed pawl spring from its post. With an 8-ounce scale held in a horizontal position and hooked in the spring eye, a pull of 2¼ to 3¼ ounces should be required to pull the spring to its position length.

c. ADJUSTMENT. Replace with new spring. Rehook the spring and remount the type-bar assembly, the type-bar backstop, and the ribbon carrier. Be careful to get the ribbon lock-out bar, the detent spring (fig. 204), and the ribbon-oscillator lever (fig. 202) in their slots.

215. Pull-Bar Guide
(fig. 194)

a. PREPARATION. The type-bar carriage must be on the typing unit.

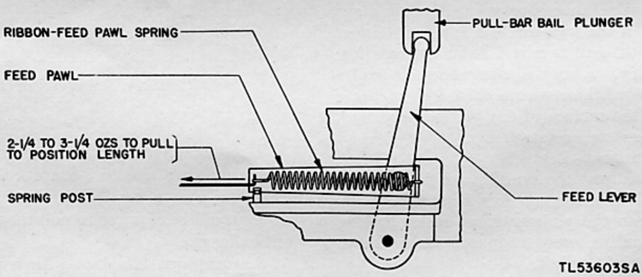


Figure 193. Ribbon-feed pawl spring.

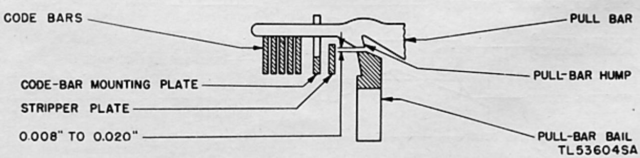


Figure 194. Pull-bar bail and stripper plate.

b. REQUIREMENTS. With the pull-bar bail in its extreme rear position, move the code bars to the right. Then move the pull-bar bail opposite the pull-bar humps. There should be a clearance of 0.008 inch to 0.020 inch between the humps on all the pull bars (*except the blank function pull bar*) and the pull-bar bail. With the code bars moved to the left, there should be a like clearance between the blank pull-bar hump and the pull-bar bail.

c. ADJUSTMENT. When checking this adjustment, all the play of the pull-bar bail should be taken up in a direction to make the clearance a minimum. To adjust, remove the bell crank mounting plate assembly (fig. 97) from the type-bar carriage assembly. Be careful not to bend the bell crank retainers. Position the pull-bar guide by means of the elongated mounting holes to secure the specified clearance.

216. Ribbon-Feed Shaft Bearing Plates

(figs. 195 and 196)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS.

(1) The left end of the ribbon-feed shaft should be flush with, or extend not more than 0.015 inch over, the inner end of the left vertical feed shaft bevel gear teeth, when the ribbon-feed shaft is in its left position and the left vertical feed shaft bevel gear is engaged with the ribbon-feed shaft gear.

(2) A similar condition should exist when the ribbon-feed shaft is in its right position, and the right vertical feed shaft bevel gear is engaged with it.

c. ADJUSTMENT. Loosen the mounting screws of both the right and left ribbon-spool brackets, and move the brackets upward as far as the elongated mounting holes will permit. Tighten the mounting screws with the brackets vertical, and at right angles to the casting. Adjust the right bearing plate by means of its clamping nuts to meet the first requirement. Adjust the left bearing plate in a similar manner, with the ribbon-feed shaft in its right position, to meet the second requirement. Check the lateral movement of the ribbon-feed shaft (movement from one detented position to the other); it should measure at least $\frac{3}{16}$ inch. If necessary, refine the ribbon-feed shaft bearing plates adjustment.

217. Ribbon-Feed Shaft Detent Spring

(fig. 195)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS.

(1) The center of the ribbon-feed shaft detent roller should be at the same height as the center of the ribbon-feed shaft, and the shaft detent should travel equally, on either side of the detent roller, when the shaft is moved from its extreme left to its extreme right position (or from its extreme right to its extreme left position).

(2) With the ribbon-feed shaft in its extreme left position, hook a 32-ounce scale over the detent roller hub and pull horizontally toward the rear of the type-bar carriage. It should require a pull of 19 to 23 ounces to start the roller moving away from the detent. Also, check this spring pressure with the shaft in its extreme right position. The two spring pressure scale readings should be within 2 ounces of being equal.

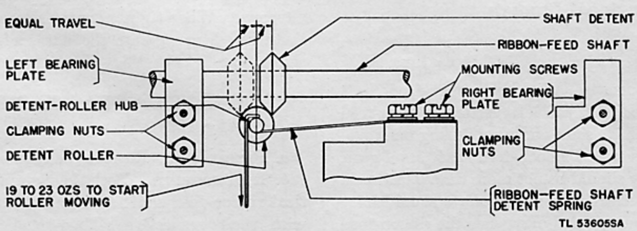


Figure 195. Ribbon-feed shaft detent.

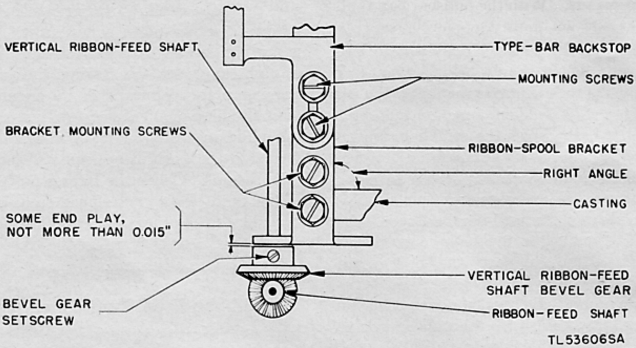


Figure 196. Vertical ribbon-feed shafts.

c. ADJUSTMENT. Loosen the mounting screws of the ribbon-feed shaft detent spring and position the spring. To increase, or decrease, the spring pressure, remove the spring and bend it. To equalize pressure, position the spring to the right or left.

218. Vertical Ribbon-Feed Shafts
(fig. 196)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. The lower ends of the right and left vertical ribbon-feed shafts should be flush with the outside edges of their respective bevel gears.

c. ADJUSTMENTS. Loosen the bevel gear setscrews. Move the bevel gears, then tighten the screws making sure that when the setscrews are tight they bear against the flat surfaces on the shafts.

219. Ribbon-Spool Brackets
(fig. 196)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. With the ribbon-feed shaft in its left position, the left vertical ribbon-feed shaft should have some end play during one revolution of the vertical ribbon-feed shaft bevel gear. This end play should be not more than 0.015 inch. The right vertical ribbon-feed shaft should have the same amount of end play when the ribbon-feed shaft is in its right position. When checking the vertical feed shafts for end play, take up the bearing play of the ribbon-feed shaft in a direction so as to make the end play of the vertical shaft maximum.

c. ADJUSTMENT. Adjust both the right and left ribbon-spool brackets by means of their elongated mounting holes. Be sure that the brackets are vertical and at right angles to the casting.

220. Ribbon-Spool Shaft Spur Gears
(fig. 197)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. The ribbon-spool shafts should have some end play, but not more than 0.006 inch.

c. ADJUSTMENT. Loosen the setscrews of the vertical ribbon-feed shaft spur gears. Move the gears out of engagement with their respective ribbon-spool shaft spur gears. Position the ribbon-spool shaft spur gears by means of their setscrews. When tightening the setscrews, be sure that they bear against the flat surfaces on the shafts.

221. Vertical Ribbon-Feed Shaft Spur Gears
(fig. 197)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. Both the right and left vertical ribbon-feed shaft spur gears should line up with their respective ribbon-spool shaft spur gears.

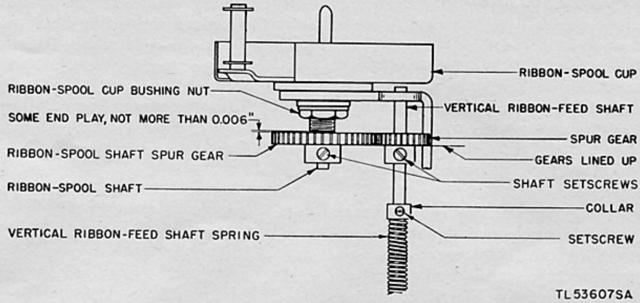


Figure 197. Ribbon-spool shaft spur gears.

c. Adjustment. Position the vertical ribbon-feed shaft spur gears, by means of their setscrews, making sure that the setscrews bear against the flat surfaces on the shafts.

222. Ribbon-Spool Cups
(fig. 198)

a. Preparation. Remove the type-bar carriage.

b. Requirements. The centers of the ribbon rollers should be ¾ to ⅞ inch in front of a line through the centers of the ribbon-spool shafts. The ribbon-spool shaft spur gears and the vertical ribbon-feed shaft spur gears should not bind at any point of their engagement.

c. Adjustment. Position each ribbon-spool cup by means of the nut on its ribbon-spool cup bushing. When tightening the nut, take up the play between the ribbon-spool cup bushing and the bracket in a direction that will result in maximum play between the spur gears. This adjustment applies only to units not equipped with the ribbon-reverse yield mechanism.

223. Vertical Ribbon-Feed Shaft Spring
(figs. 197 and 198)

a. Preparation. Remove the type-bar carriage.

b. Requirements. Move the ribbon-feed shaft to the right, disengaging its gear from the gear on the left vertical feed shaft. Hook an 8-ounce scale onto the pin on the left ribbon-spool shaft and pull in a horizontal direction. A pull of 2 to 4½ ounces should be required to start the shaft turning. Move the ribbon-feed shaft to the left, and in the same way check the spring tension of the right vertical ribbon-feed shaft.

c. Adjustment. To get the proper tension, loosen the setscrews and move the collars on the vertical feed shaft (fig. 197). Tighten the setscrews.

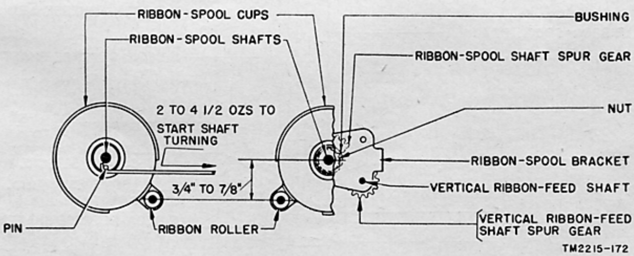


Figure 198. Ribbon-spool cups.

224. Ribbon-Reverse Shaft

(figs. 199 and 200)

a. Preparation. Remove the type-bar carriage.

b. Requirements. There should be a clearance of 0.040 inch to 0.060 inch between the bottoms of the ribbon-spool cups and the upper ends of the ribbon-reverse shafts when the ribbon-reverse arms are held against the ribbon-spool brackets.

c. Adjustments.

(1) To adjust typing units not equipped with ribbon yield mechanism, loosen the setscrew of the left ribbon-reverse arm, and, if necessary, the setscrews of the collars and the link of the left ribbon-reverse shaft. Position the shaft while holding the ribbon-reverse arm up against the ribbon-spool bracket, and then tighten the ribbon-reverse arm setscrew. Adjust the right ribbon-reverse shaft in the same manner (fig. 199).

(2) To adjust typing units equipped with the ribbon yield mechanism, loosen the setscrew of the spring block on the left ribbon-reverse shaft, and, if necessary, the setscrews of the ribbon-reverse shaft collar and link. Position the shaft while holding the ribbon-reverse arm against the ribbon-spool bracket and the spring block up against the reverse arm. Then tighten the spring block setscrew. Adjust the right ribbon-reverse shaft in the same manner (fig. 200).

225. Ribbon-Reverse Shaft Collars

(fig. 199)

a. Preparation. Remove the type-bar carriage.

b. Requirements. The ribbon-reverse shafts should have some end play, but not more than 0.008 inch. The ribbon-reverse shaft collars should be positioned so that there is 1/4 to 3/8 inch between the centers of the setscrews and the edges of their respective ribbon-spool brackets.

c. Adjustments. Position the collars by means of their setscrews while holding both ribbon-reverse arms forward against their stops.

226. Ribbon-Reverse Shaft Links

(fig. 201)

a. Preparation. Remove the type-bar carriage.

b. Requirements. The ribbon-reverse bail should clear both the left and the right ribbon-reverse pawls by 0.015 to 0.040 inch when the pull-bar bail is in its extreme rear position, and both the left and the right ribbon-reverse arms are held

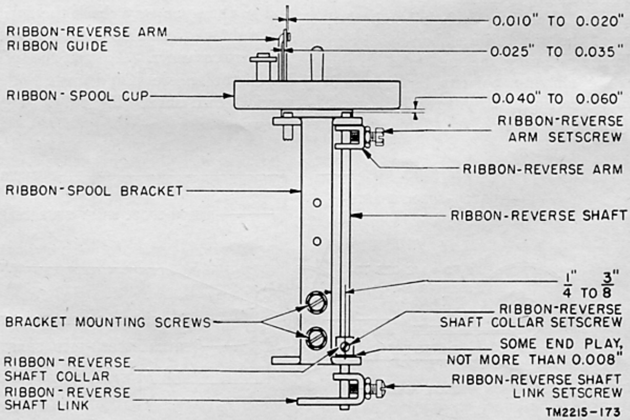


Figure 199. Ribbon-reverse shaft, old style.

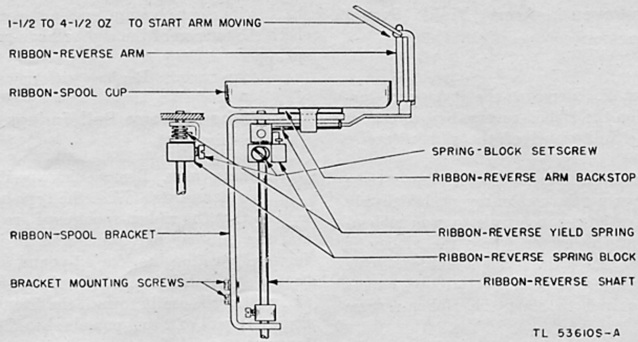


Figure 200. Ribbon-reverse shaft, new style.

forward against their stops. When checking the 0.015-inch clearance between either ribbon-reverse pawl and ribbon-reverse bail, take up the play in a direction that will make the clearance a minimum. When checking for the 0.040-inch clearance, take up the play in a direction that will make the clearance a maximum.

c. Adjustment. Position the ribbon-reverse shaft links by means of their setscrews. At the same time make sure that the ribbon-reverse pawl links do not bind at their shoulder screws, and that the right ribbon-reverse shaft link clamping screw does not interfere with the screw by means of which the ribbon-feed ratchet friction spring is anchored to the carriage casting.

227. Ribbon-Spool Cups and Ribbon-Reverse Arm Backstops

(figs. 198 and 199)

a. Preparation. Remove the type-bar carriage.

b. Requirements. The centers of the ribbon rollers should be 3/4 to 7/8 inch in front of a line through the centers of the ribbon spools, with the rear of the carriage toward the operator. With the ribbon-reverse arms held against their backstops, approximately 3/4 of the notch on each ribbon-reverse pawl should be in a position to be engaged by the ribbon-reverse bail. There should be no bind between the ribbon-spool shaft spur gears and the vertical ribbon-feed shaft spur gears at any point in their engagement.

c. Adjustment. To adjust, position each ribbon-spool cup and ribbon-reverse arm backstop by means of the nut on the ribbon-spool cup bushing. When tightening the nut, take up the play between the ribbon-spool cup bushing and the ribbon-spool bracket in a direction to make the play between the spur gears a maximum. This adjustment applies only to units equipped with the ribbon-reverse yield mechanism.

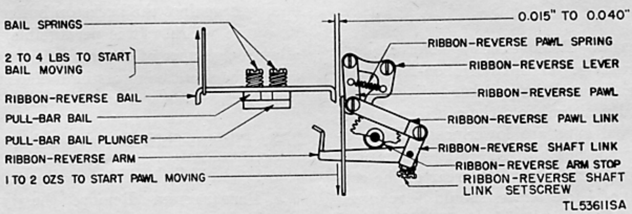


Figure 201. Ribbon-reverse mechanism.

228. Ribbon-Reverse Arms Yield Spring Tension
(fig. 200)

a. Preparation. Remove the type-bar carriage. Position the ribbon-reverse bail so that it will block the full travel of the ribbon-reverse arm.

b. Requirements. With the ribbon-reverse pawl resting against the ribbon-reverse bail, apply the push end of an 8-ounce scale to each ribbon-reverse arm at the center where the ribbon is threaded; hold the scale at right angles to the ribbon-reverse arm. A push of $1\frac{1}{2}$ to $4\frac{1}{2}$ ounces should be required to start the ribbon-reverse arm moving.

c. Adjustment. To increase or decrease the tension, remove the ribbon-reverse arm yield spring and bend the spring. Replace the ribbon on the type-bar carriage.

229. Ribbon-Reverse Arm Yield Spring and Backstop Feature
(fig. 200)

With the ribbon-reverse arm yield spring and backstop feature added, the adjustment procedure varies from the standard, as follows: Omit the ribbon-spool cups adjustment (par. 222). Perform the vertical ribbon-feed shafts spring tension adjustment (par. 223), the ribbon-reverse shafts adjustment (par. 224), the ribbon-reverse shafts collars adjustment, the ribbon-reverse shafts links adjustment (pars. 225 and 226), the ribbon-spool cups and ribbon-reverse arm backstops adjustments, the ribbon-reverse arm yield spring tension (pars. 227 and 228), the ribbon-reverse pawl spring tension, and the ribbon-reverse bail spring compression adjustments (pars. 230 and 231).

230. Ribbon-Reverse Pawl Springs
(fig. 201)

a. Preparation. Remove the type-bar carriage.

b. Requirements. With the ribbon-feed shaft in its left position and the pull-bar bail in its extreme forward position, hold the carriage so that the ribbon-spool cups are lowermost. Hook 8-ounce scale in the notch of the left reverse pawl and pull horizontally toward the rear of the carriage. A pull of 1 to 2 ounces should be required to start the pawl moving. Move the ribbon-feed shaft to its right position, and in the same manner check the tension of the right ribbon-reverse pawl spring.

c. Adjustment. Replace with new springs.

231. Ribbon-Reverse Bail Springs
(fig. 201)

a. Preparation. Remove the type-bar carriage.

b. Requirements. With the type-bar carriage held so that the ribbon-spool cups are lowermost, and the pull-bar bail plunger is in its extreme forward position, hook a 12-pound scale in the corner at the left end of the ribbon-reverse bail and pull horizontally toward the front of the carriage. A pull of 2 to 4 pounds should be required to just start the ribbon-reverse bail moving. Measure the right spring compression at the right end of the ribbon-reverse bail, for this requirement, in the same manner.

c. Adjustment. Replace with new springs.

232. Type-Bar Backstop
(fig. 196)

a. Preparation. Remove the type-bar carriage.

b. Requirements. With the pull-bar bail in its extreme rear position, there should be not less than 0.010-inch clearance between the type-bar backstop and the pull-bars when the type bars are held in the type-bar guide. Make this check on the two end pull bars and the middle pull bar.

c. Adjustment. To meet this requirement, set the up and down position of the type-bar backstop by means of its elongated mounting holes (fig. 196). When meeting the clearance requirement between the backstop and the pull bars, position the backstop low enough to eliminate any interference between adjacent type-bar assemblies at the pallet ends which would be likely to cause light printing. It is preferable that the end type bars rest against the backstop buffer strip along its entire width. It is permissible, however, to allow a clearance of not more than 0.010 inch between the front edge of the buffer strip and the type bars.

233. Ribbon-Shift Lever Bracket
(figs. 202 and 203)

a. Preparation. Remove the type-bar carriage.

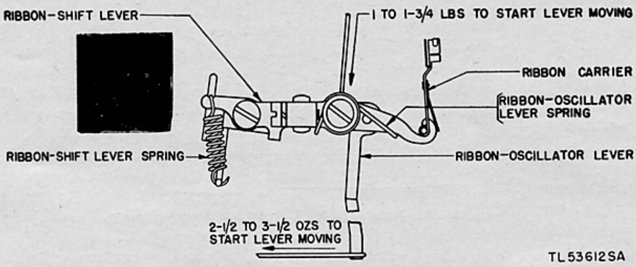


Figure 202. Ribbon-shift and ribbon-oscillator levers.

b. REQUIREMENTS. The ribbon-oscillator lever should move freely in its slot when its spring is unhooked and the ribbon carrier is located approximately centered, with respect to the type-bar guide.

c. ADJUSTMENT. Position the ribbon-shift lever bracket by means of its enlarged mounting holes. Replace the ribbon-oscillator lever spring.

234. Ribbon-Oscillator Lever Spring

(fig. 202)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. With the ribbon-shift lever spring removed, hook an 8-ounce scale over the lower end of the ribbon-oscillator lever and pull horizontally toward the rear of the type-bar carriage. It should require a pull of $2\frac{1}{2}$ to $3\frac{1}{2}$ ounces to start the oscillator lever spring moving.

c. ADJUSTMENT. Replace with a new ribbon-shift lever spring.

235. Ribbon-Shift Lever Spring

(fig. 202)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. With the ribbon-oscillator lever spring unhooked from the oscillator lever, apply the push end of a 12-pound scale, held in a vertical position, to the ribbon-shift lever at the place where the ribbon-oscillator lever spring is mounted. It should require a force of 1 to $1\frac{3}{4}$ pounds to start the shift lever moving.

c. ADJUSTMENT. Replace with a new ribbon-shift lever spring.

236. Margin-Bell Pawl Spring

(fig. 203)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. Hook an 8-ounce scale, held in horizontal position, over the margin-bell pawl, just above the stop. A pull of $\frac{1}{2}$ to $1\frac{1}{2}$ ounces

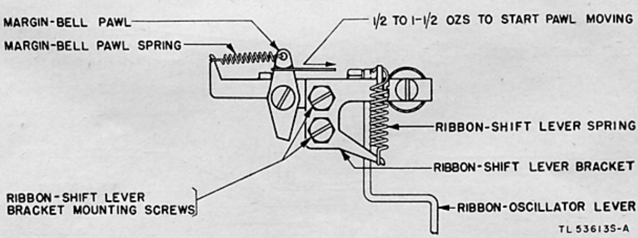


Figure 203. Margin-bell pawl.

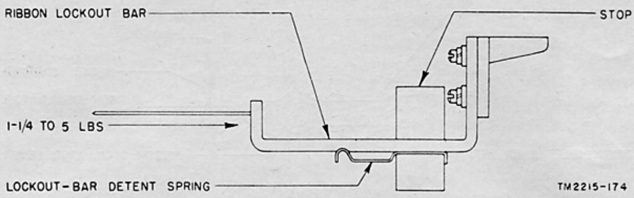


Figure 204. Adjustable ribbon lock-out bar detent spring.

in line with the spring should be required to start the pawl moving.

c. ADJUSTMENT. Replace with a new spring.

237. Adjustable Ribbon Lock-Out Bar Detent Spring
(fig. 204)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. With the ribbon lock-out bar in its unoperated position (extreme right), and with the push end of a 12-pound scale bearing against the ribbon lock-out bar in a direction in line with the bar, it should require 1¼ to 5 pounds to disengage the ribbon lock-out bar detent spring from its notch in the lock-out bar.

c. ADJUSTMENT. Replace with a new spring.

238. Mounting of Bell Crank Assembly
(fig. 205)

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. This is only a preliminary adjustment. Refer to paragraph 350 for final adjustment data.

c. ADJUSTMENT. Place the bell cranks in their lowest position, with respect to the code bars, by means of the bell crank eccentric bushings. Then mount the bell crank assembly as follows:

(1) Mount the right end of the bell crank assembly with one of its mounting screws, so that it is frictiontight.

(2) Rotate the assembly in a clockwise direction and engage the five bell cranks with their respective code bars.

(3) Replace the left mounting screw and tighten both the left and right screws.

239. Right Pull-Bar Spring Bracket
(fig. 206)

Note. This paragraph applies only to typing units equipped with a three-section pull-bar bracket.

a. PREPARATION. Remove the type-bar carriage.

b. REQUIREMENTS. With the pull-bar bail in its extreme rear position, the right end pull bar and the fourth pull bar from the right end should have some play, but not more than 0.004 inch, between the right spring bracket and the type bar when the type bar is in its guide.

c. ADJUSTMENT. Loosen the mounting screw of the right pull-bar spring bracket and position the

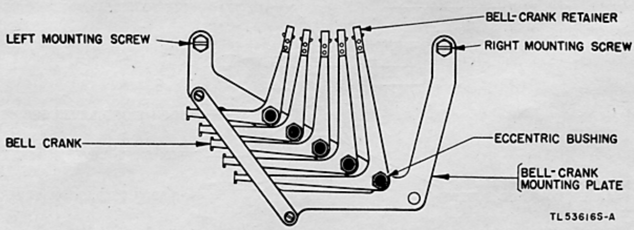


Figure 205. Bell crank assembly.

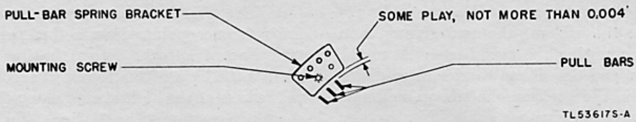


Figure 206. Pull-bar spring bracket.

bracket. Tighten the screw. If the second or third pull bar from the end binds against the spring bracket when their respective type bars are moved to the platen, manually, readjust the spring bracket so that all four pull bars are free; also so that the end pull bar and at least one of the other three pull bars have not more than 0.004-inch clearance, between the type bars and the spring bracket, when their type bars are in the type-bar guide.

240. Left Pull-Bar Spring Bracket
(fig. 206)

Note. This paragraph applies only to typing units equipped with a three-section pull-bar bracket.

a. Preparation. With the pull-bar bail in its extreme rear position, the left end pull bar and the third pull bar from the left end should have some play, but not more than 0.004 inch, between the left spring bracket and the type bar when the type bar is in the type-bar guide.

b. Adjustment. Loosen the mounting screw of the left pull-bar spring bracket and position the bracket. Tighten the screw. If the second pull bar from the left binds against the bracket, readjust the spring bracket so that the end pull bar and the second pull bar from the left end have a clearance of not more than 0.004 inch, between the left spring bracket and the type bar, when the type bar is in the type-bar guide.

241. Margin Adjusting Screw Arm Spring
(fig. 207)

a. Preparation. Remove the type-bar carriage.

b. Requirements. With the notch in the right margin adjusting screw arm engaged with the detent spring, hook a 12-pound scale over the adjusting screw and pull at right angles to the arm toward the rear of the type-bar carriage. It should require a pull of 2 to 4 pounds to disengage the arm from the detent spring.

c. Adjustment. Replace with a new spring.

242. Carriage Support and Pull-Bar Bail Plunger Rollers
(fig. 102)

a. Preparation. Remove the type-bar carriage.

b. Requirements. The three carriage support rollers and the pull-bar bail plunger roller should turn freely without end play.

c. Adjustment. Loosen the lock nuts and adjust the cone nuts. The rollers should turn freely without end play after the lock nuts are tightened.

243. Instructions for Replacing a Type Bar

The type-bar guide adapter plate, located between the type-bar guide and the type-bar segment, is positioned at the factory for type alinement and should not be disturbed as it may

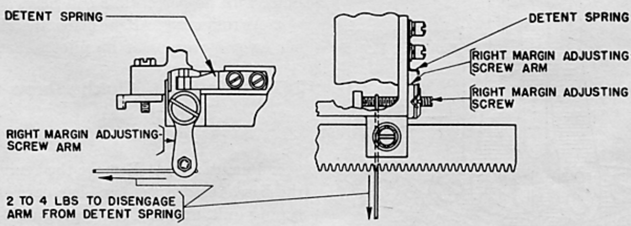


Figure 207. Right margin adjusting screw and detent spring.

seriously affect the alinement. Remove the type-bar carriage, the ribbon, the two screws, and lockwashers mounting the type-bar guide to the adapter plate, and the ribbon carrier after disengaging it from the hook on the ribbon-oscillator lever. Then lift the type-bar guide off its dowels; raise the type bar until it passes the ribbon-oscillator lever, then raise the selected pull bar until it is disengaged from the type bar, and remove the type bar from its slot in the type-bar segment. Insert the new type bar in the slot just vacated, engaging the teeth on the pull bar so the top of the pull bar is even with that of the other pull bars when the type bar is resting against its backstop. New type bars are usually oversized and the section that fits in the segment will probably have to be stoned down to permit it to operate freely. Do not remove more metal than is necessary for freedom of movement. Reassemble the type-bar guide on the adapter plate using the two screws and lockwashers previously removed, the ribbon carrier on the type-bar guide engaging its lower end in the ribbon-oscillator lever hook, and the type-bar carriage on the typing unit.

244. Type-Bar Guide Adapter Plate

(fig. 208)

a. Preparation. Place the type-bar carriage on the typing unit and then place the typing unit on the base.

b. Requirements. The characters in any printed line must line up with each other within $\frac{1}{64}$ inch. To test for this requirement, type a test line. With the base of the lowest letter as the reference point, draw a line parallel to the type line of letters. From the line which represents the base of the lowest character, measure to the base of the highest character; the difference should be no more than $\frac{1}{64}$ inch (fig. 179).

c. Adjustment. Loosen the type-bar guide adapter plate mounting screws until they are friction tight, and move the top of the type-bar guide to the left or right as required. When the adjustment is made correctly, the extreme right and left characters (S and Z) and the center character (N) all should aline.

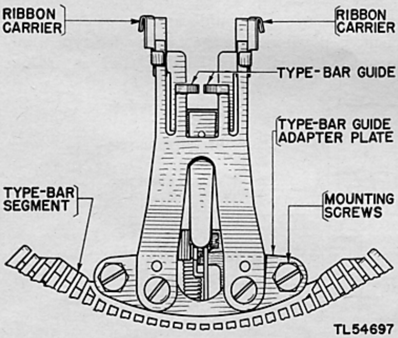


Figure 208. Type-bar guide adapter plate.

245. Main Shaft (Selector Cams)

(fig. 209)

a. Preparation. Remove the typing unit from the base and rest the typing unit on its right side.

b. Requirements. When the main shaft is rotated, the selector cams on the selector cam sleeve should line up with their respective selector levers.

c. Adjustment. Loosen the four screws that hold the main-shaft bearing caps and position the main shaft. Tighten the bearing cap mounting screws.

246. Main-Shaft Clutch Throw-Out Lever

(fig. 210)

a. Preparation. Remove the typing unit from the base and rest the typing unit on its right side.

b. Requirements. With the clutch driven member fully cammed out of engagement with the driving member by the clutch throw-out lever, there should be 0.010- to 0.020-inch clearance between the ends of the clutch teeth. The clutch throw-out lever should be free and should not bind, with no perceptible end play.

c. Adjustment. Reposition the clutch throw-out lever by means of its pilot screws.

247. Main-Shaft Clutch Throw-Out Lever Spring

(fig. 210)

a. Preparation. Remove the typing unit from the base, remove the type-bar carriage from the typing unit, and rest the typing unit on its right side. Rotate the main shaft until the clutch teeth are fully engaged.

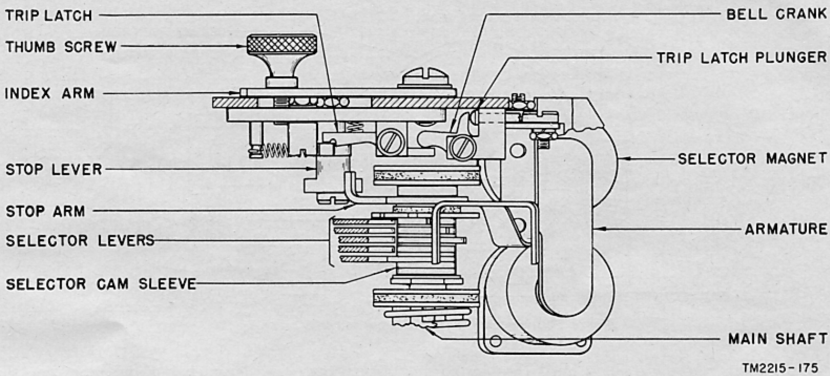


Figure 209. Selector cam and lever alinement.

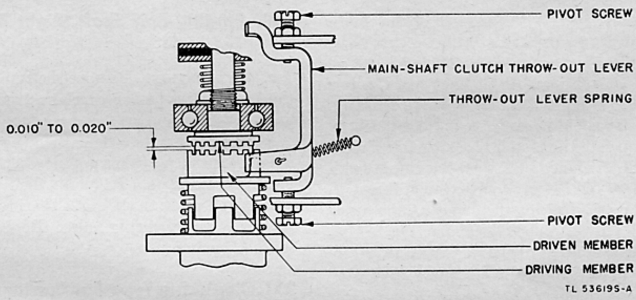


Figure 210. Main-shaft clutch.

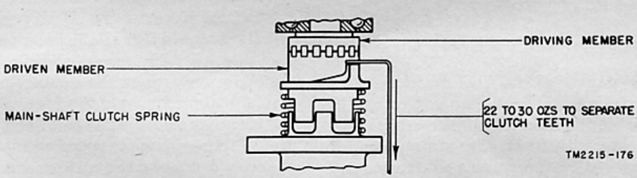


Figure 211. Main-shaft clutch spring.

b. Requirements. Hook an 8-ounce scale, held in horizontal position, over the clutch throw-out lever at the spring hole and pull at right angles to the throw-out lever. It should require a pull of 2½ to 4 ounces to start the lever moving.

c. Adjustment. Replace with a new spring.

248. Main-Shaft Clutch Spring
(fig. 211)

a. Preparation. Remove the typing unit from the base, remove the type-bar carriage from the typing unit, and rest the typing unit on its right

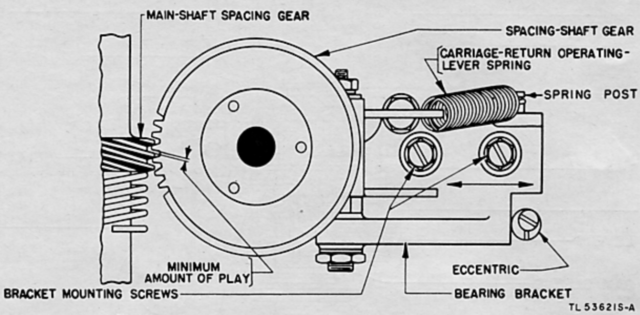


Figure 212. Spacing-shaft gear and lower bearing bracket.

side. Rotate the main shaft until the low part of the printing-bail cam is toward the bottom of the typing unit.

b. REQUIREMENTS. With the teeth of the clutch driven member resting against the teeth of the driving member, but *not* engaged, hook a 32-ounce scale on the driven member in line with the low part of the printing-bail cam and pull vertically, downward. It should require a pull of 22 to 30 ounces to separate the clutch teeth. After checking the 22- to 30-ounce pull with the clutch teeth still separated, reduce, gradually, the spring tension exerted by the scale on the driven clutch member. The clutch teeth should engage, top to top, before the scale reading drops to 10 ounces.

c. ADJUSTMENT. Replace with a new spring.

249. Spacing-Shaft Lower Bearing Bracket (fig. 212)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS. Hold the spacing-escapement pawl away from the ratchet and rotate the spacing gear shaft. There should be a minimum amount of play, without binding at any point of engagement, between the spacing-shaft gear and the main-shaft spacing gear during one complete revolution of the spacing-shaft gear.

c. ADJUSTMENTS. Set the typing unit in its normal upright position, unhook the carriage-return operating lever spring from the spring post, move the eccentric away from the bearing bracket, and position the bracket by means of its elongated mounting holes. Replace the carriage-return operating lever spring and reposition the eccentric against the bearing bracket.

250. Printing-Bail Shaft, Right Bearing (fig. 213)

a. PREPARATION. Remove the typing unit from the base, the type-bar carriage from the typing unit.

b. REQUIREMENTS. The printing bail should have some end play, but not more than 0.015 inch.

c. ADJUSTMENTS. Remove the printing-bail spring and position the right bearing by means of its elongated mounting holes. Replace the printing-bail spring.

251. Replacing Type-Bar Carriage on Typing Unit

Shift the platen to the FIGS position and rotate the main shaft until the printing bail is in its rear position. Then move the right margin adjusting screw arm on the carriage to the rear so that it is approximately 45° from vertical. Hold the carriage in the right hand and rest the left front carriage support roller on the right end of the front carriage track, making sure that the carriage guide screw engages the slot in the carriage track. Move the carriage slowly to the left until the rear carriage support roller rests on the upper track. Operate the carriage-return lock bar and move the pull-bar bail to its rearmost position by pushing on the right pull-bar bail roller with the right thumb. Move the carriage farther to the left, making sure that the bell cranks engage their re-

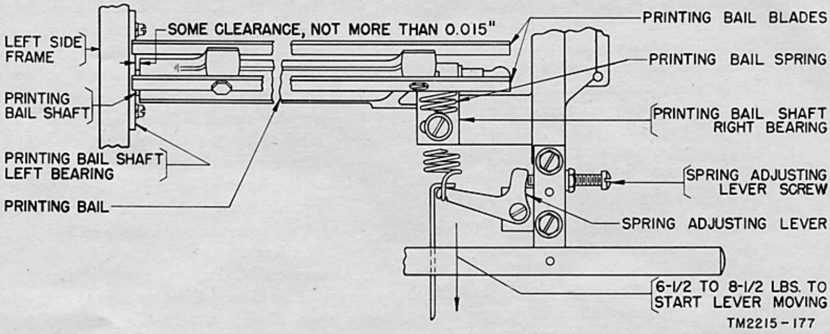


Figure 213. Printing-bail shaft, right bearing.

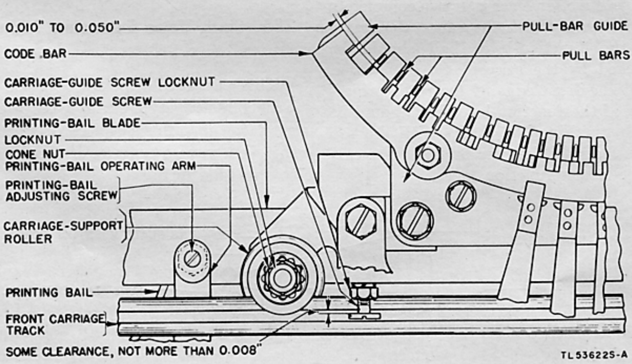
spective vanes, that the right front carriage support roller and guide screw properly engage the front carriage track, and the pull-bar bail roller is between the printing-bail blades. When the carriage has been moved far enough to the left to permit the right margin adjusting screw to clear the spacing stop lever, restore the right margin adjusting screw arm to its normal position.

252. Printing Bail
(fig. 214)

a. Preparation. Remove the typing unit from the base.

b. Requirements. The pull bars should clear the code bars by 0.010 to 0.050 inch when the main shaft is rotated until the printing bail is in its extreme rear position. Check this adjustment with the type-bar carriage in both its extreme right and left positions, and with the play in the pull bars taken up in a direction to make the clearance a minimum.

c. Adjustments. Position the printing bail by means of its adjusting screw and locknut, located on the printing-bail operating arm. If the clearance at one side is so unequal to the clearance at the other side that the 0.010- to 0.050-inch clearance cannot be obtained, it will be necessary to



Firgue 214. Printing bail and carriage track guide screw.

refine the pull-bar guide adjustment (par. 215). This is done in such a way that the clearance between the pull-bar bail and the pull-bar humps, at the side that had the least clearance, is reduced to a minimum; and that the side that had the most clearance, is increased to a maximum, for adjustment of the pull-bar bail.

253. Function–Lever Bail (Two-Piece)
(fig. 215)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. When the main shaft is rotated until the printing bail is in its rearmost position and vane No. 1 is midway between the marking and spacing positions, there should be a clearance of 0.040 to 0.060 inch between the rear edge of vane No. 1 and the front edges of the function levers (except the universal function lever).

c. Adjustment. Position the function-lever bail by means of the elongated mounting holes.

254. Blocking Plate
(fig. 215)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements.

(1) With the CAR RET combination selected, the line-feed push bar removed, and the main shaft rotated until the carriage-return function lever is drawn completely into selection with the vanes, the travel of the function-lever bail should be blocked by the selected function lever. Also the front edge of the right projection of the function-lever bail should be flush (within 0.005 inch) with the top front edge of the rear prong of the carriage-return function lever.

(2) With the LINE FEED combination selected, the line-feed push bar removed, and the main shaft rotated until the line-feed function lever is drawn completely into selection with the vanes, the travel of the function-lever bail should be blocked by the selected function lever. Also the front edge of the left projection of the function-lever bail should be flush (within 0.005 inch) with the front edge of the rear prong of the line-feed function lever.

c. Adjustments. Position the blocking plate by means of its slotted holes to meet the requirements given above. Replace the line-feed push bar.

255. Sixth Vane
(fig. 216)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. There should be a clearance of 0.008 to 0.030 inch between the right edge of the sixth vane extension and the right end of the slot in the unshift (LTRS) push bar. The vane should have some end play, but not more than 0.004 inch.

c. Adjustments. Loosen the vane clamping screws and position the sixth vane by means of the pilot screws. Tighten the clamping screws.

256. Sixth Vane Extension Springs
(fig. 217)

This paragraph applies to those typing units having a new style sixth vane extension. This extension is a formed-piece of steel mounted on the sixth vane by means of shoulder screws and compression springs.

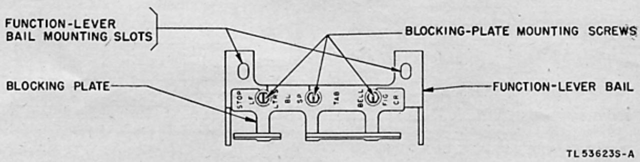


Figure 215. Two-piece function-lever bail.

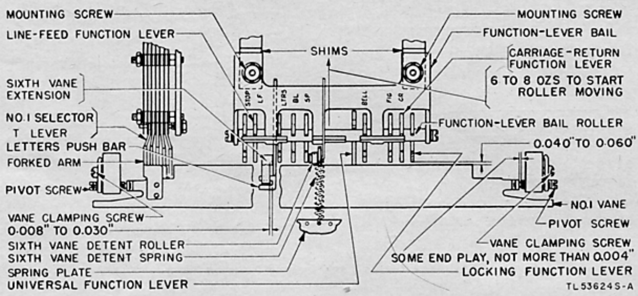


Figure 216. Associated function-lever bail parts.

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. Loosen the left pilot screw and remove the sixth vane from the typing unit. With the vane held in a horizontal position and with the vane extension upward, hook an 8-ounce scale over the upper end of the extension. Pulling at a right angle to and toward the front of the vane, a pull of ¾ to 1¼ ounces is required to start the extension moving away from the vane. Check this spring compression in the opposite direction by hooking the scale over the end of the extension and pulling toward the rear edge of the vane. Replace the vane.

c. Adjustments. Replace with new springs.

257. Selector Vanes
(fig. 216)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. The forked arms of vane Nos. 1, 2, 3, 4, and 5 should line up with their respective T levers. When the printing bail is in its extreme rear position, each vane should have some end play, but not more than 0.004 inch.

c. Adjustments. Loosen the vane clamping screws and position the vanes by means of their pilot screws. Tighten the clamping screws.

258. Function-Bail Spring
(fig. 218)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. With the function bail in its extreme rear position, unhook the function-bail spring from the front spring post and hook a 12-pound scale in the spring eye. A pull of 2 to 3 pounds should be required to extend the spring to its position length. Rehook the spring.

c. Adjustments. Replace with a new spring.

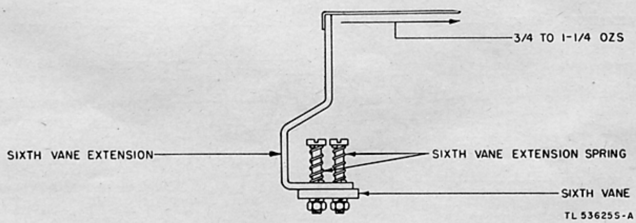


Figure 217. Sixth vane extension and springs.

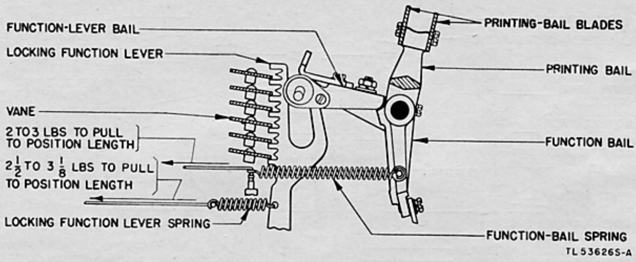


Figure 218. Function-bail and locking function-lever springs.

259. Printing-Bail Spring
(fig. 213)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position. Hook a 12-pound scale over the left end of the adjusting lever, so that the hook on the scale engages the lever directly in the rear of the spring notch in the lever. Pull in line with the spring. It should require a pull of 6½ to 8½ pounds to start the lever moving.

c. Adjustments. Adjust the spring tension by means of the spring adjusting lever screw.

260. Selector Armature Bracket Link (Friction Adjustment
(fig. 219)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit. Rest the typing unit on its right side.

b. Requirements. Remove the selector armature bracket link screw. With an 8-ounce scale hooked in the link screw hole and pulled at a right angle to the link, some tension, but not more than 8 ounces, should be required to start the link moving.

c. Adjustments. If necessary, remove the link and adjust the slotted end to obtain the specified friction (par. *b* above). Replace the link and screw.

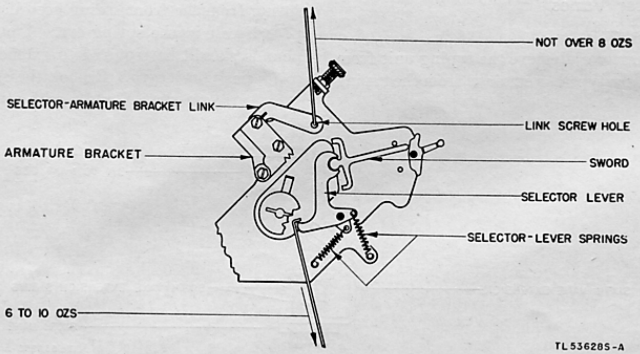


Figure 219. Selector-lever springs.

261. Selector-Lever Springs
(fig. 219)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit. Set the typing unit on its right side. Remove the rangefinder assembly (par. 191).

b. Requirements. With the code bars in marking position and the function-lever bail in its extreme forward position, manually, move the swords to the spacing position. Hook a 32-ounce scale over the end of each selector lever at the selector cam sleeve and pull in a line straight out from (or radial to) the main shaft. A pull of 6 to 10 ounces should be required to start each selector lever moving. When checking the tension of the selector-lever springs, be sure that the selector levers are free and do not bind.

c. Adjustments. Replace with new springs.

262. Selector Separator Plates
(fig. 220)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit. Remove the rangefinder (par. 191).

b. Requirements. The leaf springs should exert a *light* pressure against the swords.

c. Adjustments. Bend the leaf springs at the narrow portions so that the ends of the springs are 0.050 to 0.060 inch below the undersurface of the straight portions. Separator plate leaf springs are adjusted during the initial assembly of the unit at the factory and should require attention only if the selector has been damaged or dismantled. If it is necessary to check the adjustment, be careful to guard against distorting the selector lever springs when removing or replacing them. Final adjustment of the selector will be made easier if the swords and selector levers are replaced in the identical locations from which they were removed.

263. Selector Armature
(fig. 221)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit. Rest the typing unit upon its right side and remove the range finder assembly (par. 191).

b. Requirements. The armature should move freely on its pivot screws, with barely perceptible end play. There should be some clearance (not more than 0.008 inch) between the lower surface of the armature locking wedge and the No. 1 sword under the following conditions:

(1) The No. 1 selector lever resting on the peak of its cam.

(2) The No. 1 sword held against the upper separator plate without bending the plate.

(3) Armature end play taken up in a direction to reduce the clearance (not more than 0.008 inch) to a minimum.

c. Adjustments.

(1) If there is no clearance between the armature locking wedge and the No. 1 sword, loosen the locknut on the upper pivot screw and adjust to obtain the desired clearance. A 1/4 turn of the screw is equivalent to approximately 0.006 inch. Remove the armature bracket and adjust the lower pivot to obtain the proper armature end play. Replace the armature bracket.

(2) If there is more than 0.008-inch clearance, remove the armature bracket and adjust the lower pivot screw. Replace the bracket and adjust the armature end play by means of the upper pivot screw.

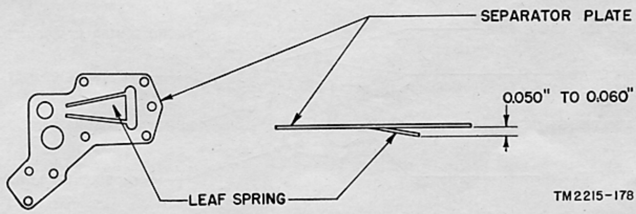


Figure 220. Selector separator plates.

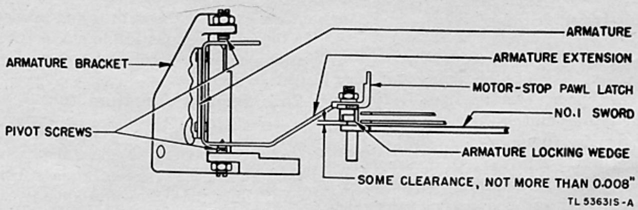


Figure 221. Selector armature.

264. Selector-Armature Bracket Link
(figs. 222 and 223)

a. Preparation. The typing unit is resting on its right side and the rangefinder and motor-stop mechanism are removed.

b. Requirements. When the No. 1 sword is held midway between the stop posts by means of the No. 72581 gage pins, the position of the armature bracket should be such that a line through the center of the No. 1 sword extends approximately through the centers of the armature pivot screws. This may be gaged quite accurately by using the 6-inch rule in Tool Equipment TE–50 or TE–50–A as a straightedge.

c. Adjustment.

(1) Unhook the locking lever spring.

(2) Loosen the magnet bracket mounting screws, and move the bracket to its rearmost position.

(3) Back off the armature stops.

(4) Loosen the armature bracket mounting screws.

(5) Loosen the bracket link screws.

(6) Move the bracket eccentric out of the way so that it will not interfere with the adjustment.

(7) Rotate the main shaft until the No. 1 selector lever rests on the peak of its cam.

(8) Hold the swords in a position midway between the two stop posts by means of the gage pins inserted between the stop posts and the swords. Be sure that both armature-extension arms are between the arms of the swords. With the swords held in this midway position, place the No. 73370 locating gage over the end of the No. 1 sword so that the two legs of the gage are against the ends of the sword arms.

(9) Move the armature bracket to a position where both armature-extension arms are against the flat surface between the legs of the gage. Use a straightedge, such as the 6-inch rule in Tool Equipment TE–50 or TE–50–A, to check that a line through the center of the armature pivot screw and a line through the center of the sword will coincide.

(10) Hold the armature bracket in this position and tighten the bracket link screw only; make the armature bracket mounting screws friction tight.

(11) Remove the locating gage and the two gage pins.

(12) Rehook the locking lever spring.

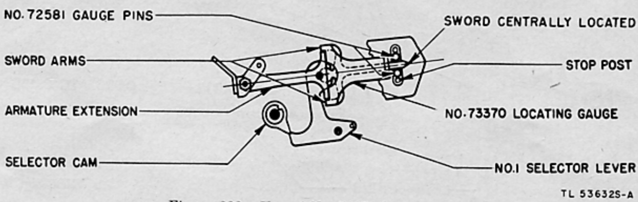


Figure 222. Use of No. 73370 locating gage.

265. Selector Armature Bracket
(fig. 223)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed from the typing unit. The armature stops are backed off. The magnet bracket mounting screws are loosened and the magnet is moved to its rearmost position. The armature bracket mounting screws are friction tight. The bracket eccentric is moved out of the way. The motor-stop mechanism is removed.

b. Requirements. The position of the armature bracket should be such as to provide some clearance, not more than 0.040 inch, between each sword and either stop post. Test for this requirement as follows:

(1) Rotate the main shaft until the No. 1 selector lever is resting on the peak of its cam. With the armature in its unoperated (spacing) position, move the spacing arm of the No. 1 sword against the armature extension. Place a 0.040-inch wire gage against the spacing stop post and move the armature slowly toward the marking position. The blade of the sword should strike the 0.040-inch gage before the armature extension leaves the spacing arm of the sword. Under these conditions the armature extension moves the sword to within not more than 0.040-inch of the stop post.

(2) With the 0.040-inch gage removed, repeat the procedure given in paragraph (1) above. The armature extension should leave the spacing arm of the sword before the blade of the sword strikes the spacing stop post. Under these conditions there is some clearance between the sword and the stop post.

(3) Unhook the armature spring at its adjusting screw and with the selector armature in its operated (marking) position, move the marking arm of the No. 1 sword against the selector armature extension. Then move the armature slowly toward the spacing position until the armature extension just leaves the marking arm of the No. 1 sword. Check the clearance between the No. 1 sword and the marking stop post in the same manner. Rehook the armature spring.

(4) With each selector lever on the peak of its cam, each associated sword should be tried, as described in paragraphs (1) and (2) above, for clearance of not more than 0.040 inch between each sword and the spacing and marking stop posts, respectively.

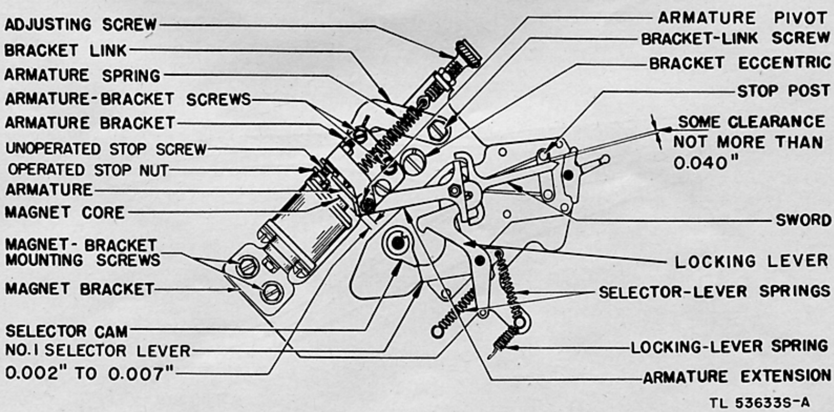


Figure 223. Selector magnet and armature mechanism.

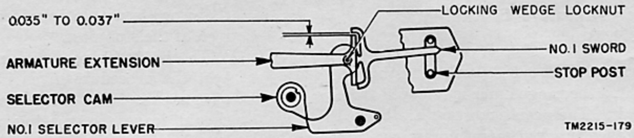


Figure 224. Sword arm clearance.

c. ADJUSTMENT.

(1) Tighten the armature bracket mounting screws just enough to allow the bracket to be moved by tapping it lightly. The clearance between the sword and the stop posts may be regulated by rotating the armature bracket on its pivot.

(*a*) If the clearance is more than 0.040 inch, move the bracket in a direction to bring the armature toward the sword.

(*b*) If there is no clearance, move the bracket in the opposite direction to move the armature away from the sword.

(2) Tighten both armature bracket screws.

(3) With the armature bracket set and both screws tightened, move the bracket eccentric against the bracket and tighten the screw.

Note. The eccentric and bracket link determine the position of the armature bracket. If it is necessary at any time to remove the armature bracket, it may be removed simply by removing the two bracket screws. In replacing the bracket, hold the armature bracket against the eccentric while the two bracket screws are tightened.

266. Armature Stops
(fig. 224)

a. PREPARATION. The typing unit is resting on its right side and the rangefinder is removed. The magnet bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor-stop mechanism is removed. Unhook the locking lever spring (fig. 223).

b. REQUIREMENTS. The right and left No. 1 sword arms should clear the associated arms of the selector armature extension .035 to .037 inch when the front edge of the opposite sword arm is against its armature-extension arm and the No. 1 selector lever is on the high part of its cam. Rehook the locking lever spring.

c. ADJUSTMENTS.

(1) To adjust the clearance of the right arm, reposition the armature stop screw (fig. 223) with the armature in its unoperated position.

(2) To adjust the clearance of the left arm, reposition the armature stop nut with the armature in its operated position. If necessary, remove the nut and pinch the slotted portion (fig. 225) to make the nut

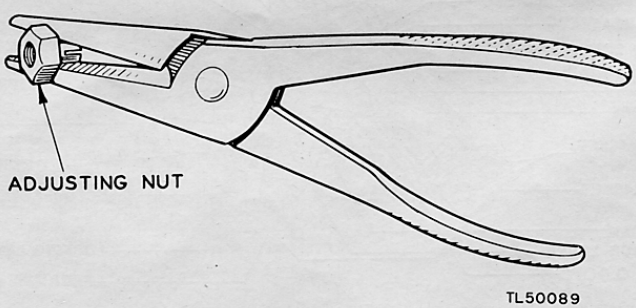


Figure 225. Pinching armature stop nut.

tight on its screw. Either the armature bracket or the magnet bracket may be removed to permit the armature stop nut to be removed. Recheck the right arm. Rehook the locking lever spring.

267. Armature Locking Wedge
(fig. 226)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed. The magnet bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor-stop mechanism is removed. Unhook the locking lever spring.

b. Requirements. There should be 0.008- to 0.012-inch clearance between the point of the armature locking edge and the point of the locking lever when the locking lever is on the long high part of the locking cam and the two points are in line.

c. Adjustment. Loosen the locking wedge locknut (fig. 221). Position the locking wedge forward or backward in its slot in the armature extension. Tighten the lock nut. Rehook the locking lever spring.

Note. When making this adjustment on typing units equipped with motor-stop mechanism, set the motor-stop pawl latch so that the shoulder of the latch is against the front face of the armature extension (fig. 221).

268. Armature Locking Lever Spring Tension
(fig.226)

a. Preparation. The typing unit is resting on its right side and the range finder is removed. The magnet bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor-stop mechanism is removed.

b. Requirements. With the locking lever on the high part of the locking cam, hook a 32-ounce scale in the spring hole of the locking lever and pull in line with the spring. A pull of 10 to 14 ounces should be required to start the lever moving. If the armature locking lever spring fails to meet requirements, replace it with a new spring.

269. Motor Stop

a. These teletypewriters are equipped with a mechanical motor-stop mechanism which permits the starting and stopping of the teletypwriter upon receipt of proper impulses over the signal line. Paragraphs 270 to 278, inclusive, apply to teletypewriters equipped with the motor-stop mechanism.

b. At this point in the adjustment procedure sequence, the motor-stop mechanism is removed from the equipment. Replace the motor-stop mechanism as follows:

(1) Place the motor-stop lever bracket in position and fasten in place with the two motor-stop lever bracket mounting screws.

(2) Rehook the motor-stop lever spring.

270. Motor-Stop Lever Bracket
(fig. 227)

a. Preparation. Remove the typing unit from the base and place the typing unit on its right side. Remove the rangefinder assembly.

b. Requirements. With the platen in the FIGS position, set up the MOTOR-STOP combination (upper case H) and rotate the main shaft slowly until the motor-stop function lever is completely selected. The latching surface of the inner motor-stop pawl should overtravel the extreme

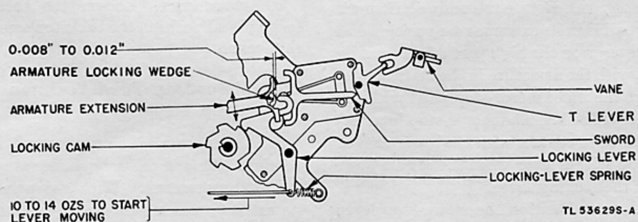


Figure 226. Armature locking wedge.

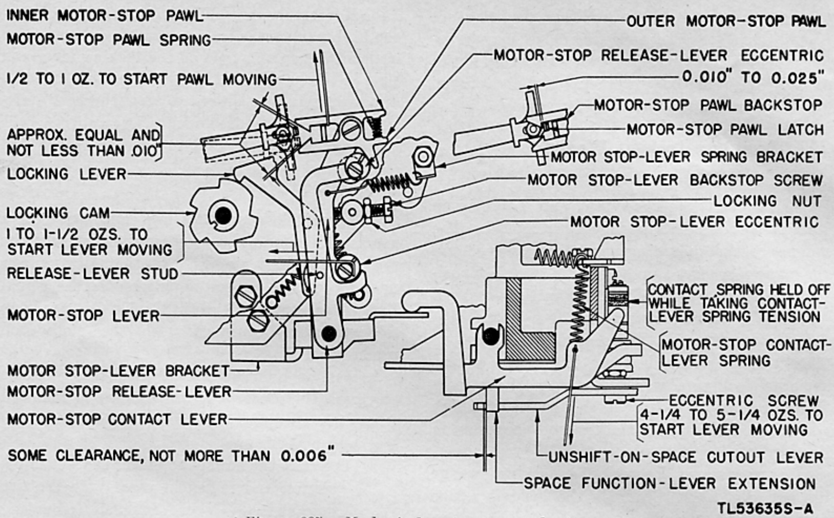


Figure 227. Mechanical motor-stop mechanism.

rear surface of the motor-stop pawl latch 0.010 to 0.025 inch when the armature is held in the marking position.

c. Adjustment. Position the motor-stop lever bracket by means of its enlarged mounting holes. When making this adjustment, the motor-stop pawl backstop should not be in contact with the inner pawl.

271. Motor-Stop Lever Eccentric
(fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position and the locking lever is on the high part of the locking cam. Then, with the armature in the marking position, engage the inner motor-stop pawl with the motor-stop pawl latch. The motor-stop lever eccentric should be in contact with the lower arm of the motor-stop release lever when the release lever stud touches the locking lever.

c. Adjustment. Position the motor-stop lever eccentric.

272. Motor-Stop Lever Backstop Screw
(fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. With the platen in the FIGS position, set up the MOTOR-STOP combination (upper case H) and rotate the main shaft until the printing bail is in its extreme forward position. Be sure that the motor-stop pawls are released from the latch. There should be some clearance, not over 0.002 inch, between the rear extension of the motor-stop function lever and the lower edge of the motor-stop lever.

c. Adjustment. Loosen the backstop screw locknut and position the backstop screw. Tighten the locknut.

273. Motor-Stop Pawl Backstop
(fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. With the printing bail in its extreme rear position and the motor-stop release lever eccentric moved away from the outer

stop pawl, the motor-stop latch should clear both motor-stop pawls by an approximately equal distance (not less than 0.010 inch) when the armature is moved to the marking or spacing positions.

c. Adjustment. Loosen the motor-stop pawl backstop mounting nut and rotate the backstop. Tighten the nut.

274. Motor-Stop Release Lever Eccentric (fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position and the locking lever is on the high part of the locking cam. Then, with the armature in the marking position, engage the inner motor-stop pawl with the motor-stop pawl latch. The motor-stop release lever eccentric should just touch the outer motor-stop pawl when the lower arm of the motor-stop release lever is in contact with the motor-stop lever eccentric and the outer pawl is against the motor-stop pawl backstop.

c. Adjustment. Loosen the motor-stop release lever eccentric mounting screw. Position the motor-stop release lever eccentric. Tighten the mounting screw.

275. Motor-Stop Pawl Spring Compression (fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. With the printing bail in its extreme rear position, hook an 8-ounce scale, held in a horizontal position, over the inner motor-stop pawl just in front of the backstop and pull at right angles to the pawl. A pull of ½ to 1 ounce should be required to start the pawl moving. If the motor-stop pawl spring fails to meet the requirements, replace it with a new spring.

276. Motor-Stop Lever Spring Tension (fig. 227)

a. Preparation. The typing unit is resting on its right side and the rangefinder is removed.

b. Requirements. Unhook the motor-stop contact lever spring, located toward the front of the typing unit. With the motor-stop lever in the unoperated position, hook an 8-ounce scale over the head of the screw which mounts the motor-stop lever eccentric, and pull toward the rear of the teletypewriter. A pull of 1 to 1½ ounces should be required to start the lever moving.

c. Adjustment.

(1) Position the motor-stop lever spring bracket on the post of the selector unit. Replace the motor-stop lever spring with a new spring if moving the spring bracket does not cause the old spring to meet the requirements.

(2) Rehook the motor-stop contact lever spring.

277. Motor-Stop Contact Lever Spring Tension (fig. 227)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. Hold off the contact spring located on the front of the typing unit if it rests on the motor-stop contact lever. Hook an 8-ounce scale in the contact lever spring hole and pull in line with the spring. A pull of 4¼ to 5¼ ounces should be required to start the contact lever moving.

c. Adjustment. If the motor-stop contact lever spring fails to meet the requirements, replace it with a new spring.

278. Motor-Stop Function-Lever Spring Tension (fig. 228)

a. Preparation. The typing unit is removed from the base. Place the typing unit in its normal upright position.

b. Requirements. With the motor-stop function lever resting against the rear edges of the vanes, but not selected, hook a 12-pound scale under the extreme front end of the lever (located on the front of the typing unit just above the right end of the motor-stop contact spring assembly) and pull at right angles to the lever and toward the top of the teletypewriter. A pull of 5 to 6 pounds should be required to start the lever moving.

c. Adjustment. If the motor-stop function-lever spring fails to meet the requirements, replace it with a new spring.

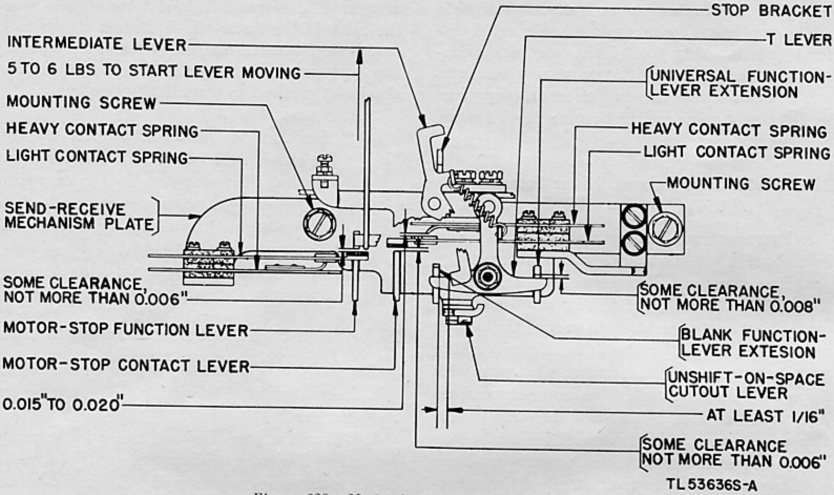


Figure 228. Mechanical motor-stop contacts.

279. Stop Lever Eccentric Screw
(fig. 229)

a. Preparation. The rangefinder assembly is removed from the typing unit.

b. Requirements. The stop lever on the rangefinder assembly should overtravel the latching surface of the trip latch not more than 0.006 inch.

c. Adjustment. Position the stop lever eccentric screw by loosening its locknut and turning the screw as required. When tightening the nut, be careful not to disturb the adjustment.

280. Stop Lever Spring Tension
(fig. 230)

a. The range-finder assembly is removed from the typing unit.

b. With the range-finder assembly bottom side up, and with the trip-latch plunger held operated,

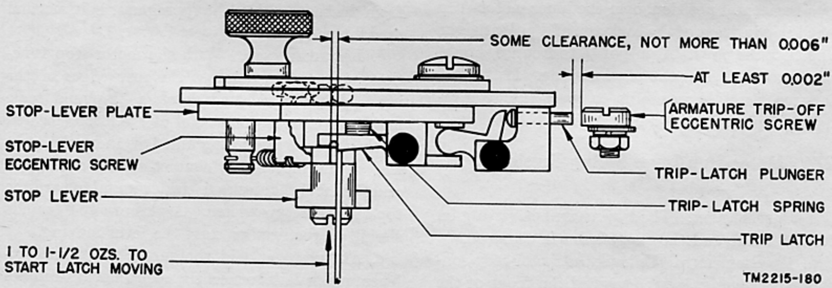


Figure 229. Rangefinder assembly.

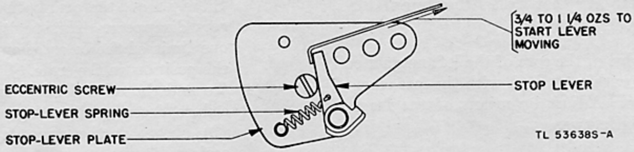


Figure 230. Stop lever spring.

hook an 8-ounce scale at the end of the stop lever on the range-finder assembly. A pull of ¾ to 1¼ ounces should be required to start the lever moving. If the stop lever spring fails to meet the requirements, replace with a new spring.

281. Trip-Latch Spring Compression
(fig. 229)

a. The range-finder assembly is removed from the typing unit.

b. Hold the range-finder assembly in a horizontal position, as illustrated in figure 229. Apply the push end of an 8-ounce scale, held in a vertical position, to the trip latch as near to the stop lever as possible; push up. A push of 1 to 1½ ounces should be required to start the trip latch moving. If the trip-latch spring fails to meet the requirements, replace with a new spring.

c. Remount the range-finder assembly. Be careful that the trip-latch plunger does not jam against the armature trip-off eccentric screw.

282. Armature Trip-Off Eccentric Screw
(fig. 231)

a. Preparation. The range-finder assembly is on the typing unit and the typing unit is resting on its right side. The magnet-bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor-stop mechanism is removed.

b. Requirements.

(1) There should be some clearance, not more than 0.002 inch, between the stop lever and trip latch when the armature is in the unoperated position and the main shaft is rotated until the stopping edge of the stop lever is directly below the latching surface of the trip latch.

(2) The trip-latch plunger should have at least 0.002-inch end play (fig. 229) when the armature is in the marking position and the stop lever is clear of the latching surface of the trip latch.

c. Adjustments.

(1) To obtain correct clearance, position the armature trip-off eccentric screw by loosening its locknut and turning the screw. Tighten the locknut.

(2) The second requirement (par. *b* (2) above) serves as a check on the trip-off eccentric-screw adjustment and also on the adjustment of the armature stops (par. 266).

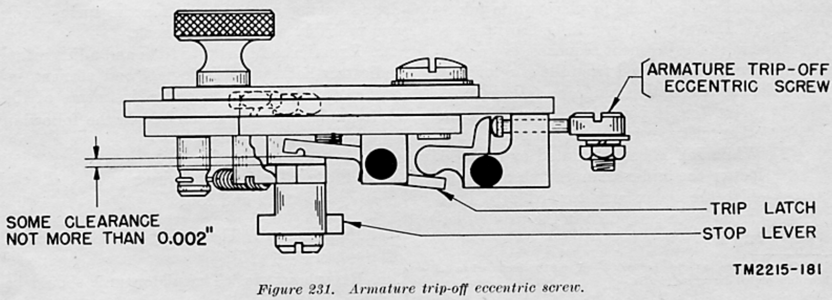


Figure 231. Armature trip-off eccentric screw.

283. Selector Magnet Coil Adjustment
(fig. 223)

The left edge of the core of the left magnet coil should aline within $\frac{1}{64}$ inch with the left edge of the armature. Adjust by means of the magnet coil mounting screws.

284. Magnet Bracket
(fig. 223)

a. PREPARATION. The typing unit is resting on its right side. The magnet-bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor-stop mechanism is removed.

b. REQUIREMENTS. There should be 0.002- to 0.007-inch clearance between each magnet core and the armature antifreeze strip when the armature is against the operated stop nut (marking stop).[1] The faces of the cores should be parallel to the face of the armature, and the sides of the cores should aline with the edges of the armature.

c. ADJUSTMENT. Position the magnet bracket by means of its enlarged mounting holes.

285. Range Finder
(fig. 189)

a. Place the type-bar carriage on the typing unit and the typing unit on the base. The selector armature spring tension measures 6 to 6½ ounces (par. 209). Connect the teletypewriter to a power outlet and, if possible, to another teletypewriter (as a source of alternate R and Y impulses). The motor-stop mechanism is removed. When using the orientation range as a general test of the condition of the teletypewriter mechanism, on units equipped with a motor-stop mechanism, the motor-stop mechanism should be in place while taking the range. However, when taking the range at this point in the adjustment sequence, the motor-stop mechanism is removed from the selector unit.

b. Take the orientation range, as follows:

(1) Print (or, if possible, receive from another teletypewriter) the letters R and Y.

(2) While RY is being printed or received, loosen the index arm thumbscrew and shift the index arm toward zero until errors begin to appear in the printed letters RY.

(3) Slowly move the arm back until the errors disappear. This position indicates one limit of the orientation range; note the position on the scale.

(4) To find the other limit, repeat the procedure, described in paragraphs (2) and (3) above, at the opposite end of the scale.

(5) After the two limits (or extreme positions of perfect printing) have been found, set the index arm of the range-finder midway between these two points.

c. Position the armature spring adjusting screw, as follows:

(1) Turn the armature spring adjusting screw in a clockwise direction until errors show in the RY.

(2) Turn the adjusting screw in a counterclockwise direction, counting the number of turns necessary to bring the spring to its high limit (where RY fails to print properly).

(3) Half this number of turns backward (in a clockwise direction) will position the adjusting screw midway between its two failing points.

(4) Lock the armature spring adjusting screw in this position.

d. Recheck the orientation range (par. *b* above).

286. Shift Mechanism

a. Tests and adjustments for the shift mechanism are described in paragraphs 287 through 300.

b. When a test or adjustment requires the removal of the shift-detent spring, do not use the spring hook supplied with Tool Equipment TE–50 or TE–50–A to remove the spring; the shift-detent spring is too heavy for the spring hook and probably will break the hook.

c. Experience in making tests and adjustments indicates that the most logical and efficient sequence for making tests and adjustments of the shift mechanism is as described in the following paragraphs.

287. Platen Unit Pilot Screws
(figs. 232 and 236)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. The platen unit should be

[1] This clearance should be 0.003 to 0.010 inch when a chromium-plated armature is used.

midway between the side frames and should be free on its bearings without side play.

c. Adjustment. With the typing unit in its normal upright position, disconnect the line-feed and shift vertical links at the upper shoulder screws. Unhook the platen balance spring and the shift-detent spring. Position the platen unit by means of its pilot screws. Then back off one pilot screw until the platen unit has some side play. Turn the pilot screw in just enough to take up the side play. Reconnect the line-feed and shift vertical links; rehook the platen balance spring and the shift-detent spring. *Do not tighten the pilot screws to the extent that they cause a strain on the side frames.*

288. Platen Shift Stop Post

(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirement. The top and bottom surfaces of the platen shift stop post should be parallel to a line through the center of the platen detent roller screw and the platen pilot screw.

c. Adjustment. Loosen the platen shift stop post nut and rotate the post. Tighten the nut.

289. LTRS Stop Screw

(fig. 232)

When the LTRS combination is selected, the platen is in the unshift (down) position; when the FIGS combination is selected, the platen is in the shift (up) position.

a. Preparation. The type-bar carriage should be in place on the typing unit. Remove the ribbon from the ribbon carrier.

b. Requirements. With the platen in LTRS position and the letter N type bar held lightly against the platen, the curved surface of the letter

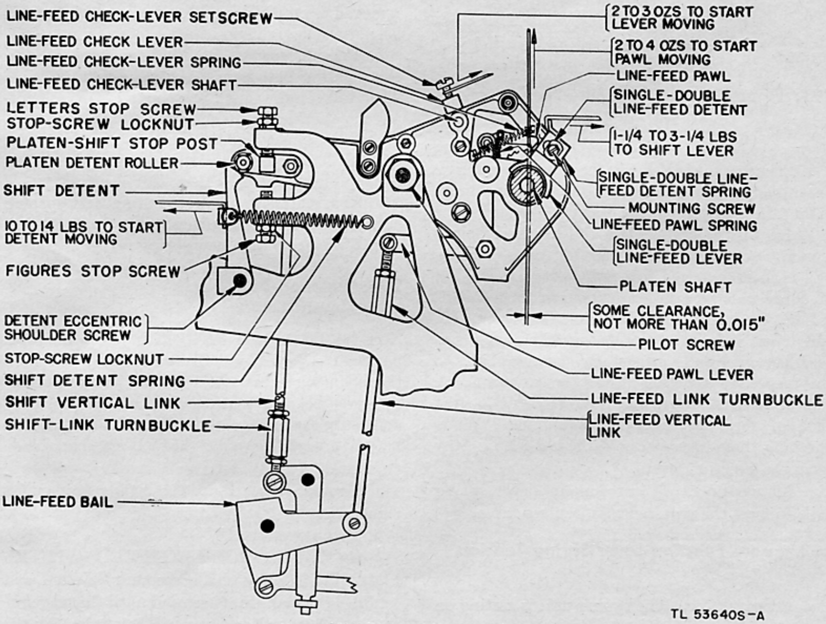


Figure 232. Platen-shifting mechanism.

N should fit the curved surface of the platen. The contact of the two surfaces can be seen best if a light is placed on the side of the type bar away from the operator. To check further, insert a sheet of paper with a carbon in the teletypewriter and press the letter N firmly against the paper and platen. The impression made by the carbon on the paper should be of uniform shade.

c. Adjustment. If the shading is lighter at the bottom of the character, raise the LTRS stop screw. If the shading is lighter at the top, lower the screw.

290. FIGS Stop Screw
(fig. 232)

a. Preparation. The type-bar carriage is in place on the typing unit. Install the ribbon on the ribbon carrier.

b. Requirements. The top of the figure 2 typed with the platen in the FIGS position should be in line with the top of the letter W typed with the platen in the LTRS position.

c. Adjustment. Raise or lower the FIGS stop screw.

291. Figures, Letters, and Line-Feed Function-Lever Spring Tensions
(fig. 233)

a. Preparation. Remove the type-bar carriage from the typing unit; place the typing unit on its right side.

b. Requirements. Select the blank combination and rotate the main shaft until the printing bail is in its extreme forward position. Hook a 32-ounce scale over the rear extension of the FIGS, LTRS, and LINE FEED function levers (in turn) just in front of the lobes which engage the push bars and pull horizontally at right angles to the respective function-lever rear extension. A pull of 15 to 19 ounces should be required to start each of these function levers moving. When checking these tensions, hold the push bars away from the function levers.

c. Adjustment. If any function-lever spring fails to meet the requirements, replace it.

292. Space Function-Lever Spring Tension
(fig. 233)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the space function lever resting against the vanes, but not selected, hook a 32-ounce scale over the rear extension of the lever, just in front of the lobe, and pull horizontally at right angles to the rear extension. A pull of 12 to 16 ounces should be required to start the space function lever moving. When checking the tension, hold the LTRS push bar away from the function lever.

c. Adjustment. If the space function-lever spring fails to meet requirements, replace it with a new spring.

293. Blank Printing and Spacing Cut-Out Function-Lever Spring Tension

This adjustment applies only to teletypewriters equipped with a special function lever to prevent printing and spacing when the blank combination is selected.

a. Preparation. The type-bar carriage is removed from the typing unit and the typing unit is removed from the base. Place the typing unit in its normal upright position.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position. Then unhook the blank printing and spacing cut-out function-lever spring from the spring plate. Hook a 32-ounce scale in the spring eye. A pull of 22 to 30 ounces is required to stretch the spring to its position length. Rehook the spring.

c. Adjustment. If the printing and spacing cut-out function-lever spring fails to meet requirements, replace with a new spring.

294. Function-Bail Blade
(fig. 235)

If the LTRS and FIGS shift mechanism has not been adjusted, it will be necessary to loosen the mounting screws of the shift bell crank operating-lever bracket (shift-link bracket) (fig. 234) and move the bracket to its extreme rear position before proceeding with the function-bail blade adjustment.

a. Preparation. Place the typing unit on its right side.

b. Requirements.

(1) With the FIGS, LINE FEED, and LTRS function levers alternately selected and the main shaft rotated until the travel of the function-lever bail is blocked by the

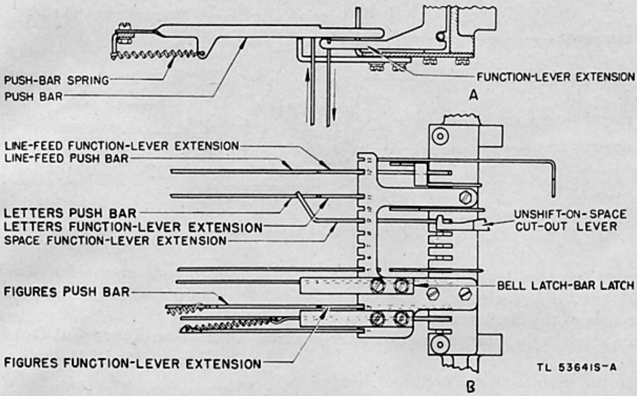


Figure 233. Function-lever extensions.

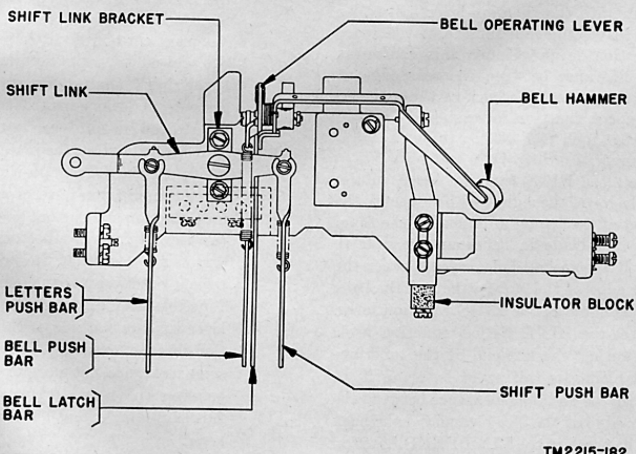


Figure 234. Shift link and bracket.

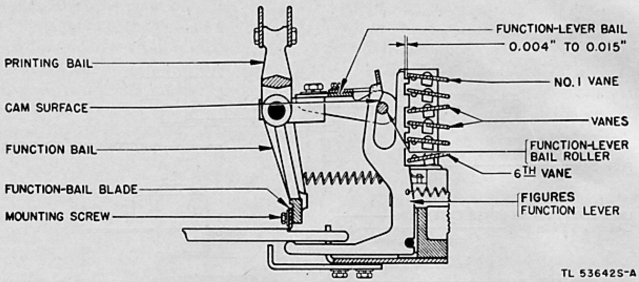


Figure 235. Function bail.

selected function lever, there should be 0.004- to 0.015-inch clearance between the rear edge of the No. 1 vane and the back of the notch in the selected function lever (fig. 235).

(2) With the unshift-on-space cut-out lever (fig. 233) released from the lower extension of the space function lever, place the platen in the FIGS position, select the space combination, and rotate the main shaft until the function-lever bail roller just leaves the cam surface of the space function lever. Under this condition, the clearance between the rear edge of No. 1 vane and the back of the notch in the space function lever should be 0.004 to 0.015 inch (fig. 235).

c. ADJUSTMENT.

(1) Select the FIGS function lever. Raise or the lower the right (with respect to the front of the typing unit) end of the function-bail blade in its mounting slots to obtain the specified clearance between the rear edge of the No. 1 vane and the back of the notch in the FIGS function lever.

(2) Select the LINE FEED function lever and adjust the left end of the function-bail blade, by raising or lowering it, to obtain the specified clearance between the rear edge of the No. 1 vane and the back of the notch in the LINE FEED function lever.

(3) If requirements are not met when the LTRS and space function levers are selected, it may be necessary to readjust both ends of the function-bail blade to obtain specified clearances.

295. Unshift-on-Space Cut-Out Lever
(figs. 227 and 233)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS.

(1) If it is desired that the platen return to the LTRS position when the space combination is received, rotate the unshift-on-space cut-out lever counterclockwise (as viewed from the bottom of the teletypewriter) against its stop. Tighten the cut-out lever eccentric-screw locknut to hold the cut-out lever in this position.

(2) If it is desired that the platen should *not* return to the LTRS position when the space combination is received, rotate the unshift-on-space cut-out lever clockwise (as viewed from the bottom of the teletypewriter), so that the hooked end of the cut-out lever is to the rear of the space function-lever extension and the cut-out lever touches the side of the space function-lever extension. There should be some clearance, not more than 0.006 inch, between the rear surface of the space function-lever extension and the cut-out lever.

c. ADJUSTMENT. Remove the T lever and attached mechanism (fig. 228) from its mounting post and loosen the cut-out lever eccentric-screw nut. Position the cut-out lever and the eccentric

screw and then tighten the locknut. Replace the **T** lever and attached mechanism.

296. LTRS and FIGS Shift
(figs. 232 and 233)

a. Preparation. The typing unit is removed from the base; place the typing unit in its normal upright position. Unhook the shift-detent spring and the platen balance spring (figs. 232 and 236).

b. Requirements.

(1) Place the platen in the **FIGS** position (up). Select the **LTRS** combination. Rotate the main shaft until the function-bail blade moves the **LTRS** push bar to its extreme rear position. The shift stop post should move to within 0.010 to 0.025 inch of the **LTRS** stop screw.

(2) Place the platen in the **LTRS** position (down). Select the **FIGS** combination. Rotate the main shaft until the function-bail blade moves the **FIGS** push bar to its extreme rear position. The shift stop post should move to within 0.010 to 0.025 inch of the **FIGS** stop screw.

c. Adjustment.

(1) Place the shift bell crank operating-lever bracket (shift-link bracket (fig. 234)) in the middle of the adjustment provided by the mounting slots and tighten the mounting screws. Place the typing unit on its right side and rotate the main shaft until the function bail is in its extreme forward position. Adjust the turnbuckle on the shift link so as to equalize (within 0.010 inch) the clearance between the function-bail blade and the shoulder on the **LTRS** push bar when the platen is in the **FIGS** position. The clearance between the function-bail blade and the shoulder on the **FIGS** push bar should be the same when the platen is in the **LTRS** position.

(2) Select the **LTRS** and **FIGS** combinations alternately and check for the specified clearances between the shift stop post and the **LTRS** and **FIGS** stop screws as described in subparagraph *b* above. If either of these clearances is greater than 0.025 inch, move the shift bell crank operating-lever bracket (shift-link bracket) toward the front of the unit. If either clearance is less than 0.010 inch, move the shift bell crank operating-lever bracket toward the rear.

(3) After adjusting the shift bell crank operating-lever bracket, a slight readjustment of the shift-link turnbuckle may be necessary to bring both clearances within the specified limits (par. *b* above).

(4) Rehook the shift-detent spring and the platen balance spring.

297. Platen Balance Spring Tension
(fig. 236)

a. Preparation. The typing unit may be on or off the base.

b. Requirement. With the platen in **LTRS** position, unhook the platen balance spring from the platen unit side frame. It should require 3½ to 5 pounds to pull the spring to position length on units equipped with cast-iron platen brackets; 1¼ to 2 pounds on units equipped with aluminum platen brackets. Rehook the platen balance spring.

c. Adjustment. If the platen balance spring fails to meet requirements, replace it with a new spring.

298. Shift Detent
(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. When the platen is shifted from the **FIGS** to the **LTRS** position, and vice versa, the platent detent roller should ride equally on either side of the shift detent.

c. Adjustment. Position the shift detent by loosening the locknut and turning the shift-detent eccentric shoulder screw. Tighten the locknut.

299. Shift-Detent Spring Tension
(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Hook a 25-pound scale over the extension on the shift detent and pull in line with the spring. A pull of 10 to 14 pounds should be required to start the detent moving.

c. Adjustment. If the shift-detent spring fails to meet requirements, replace it with a new spring.

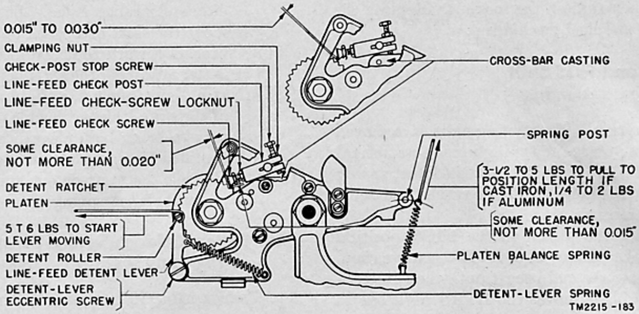


Figure 236. Line-feed mechanism and platen balance spring.

300. LTRS and FIGS Push-Bar Spring Tensions
(fig. 234)

a. PREPARATION. Place the typing unit on its right side.

b. REQUIREMENTS. With the platen in the LTRS position (down), select any character and rotate the main shaft until the printing bail is in its extreme forward position. Place the push end of an 8-ounce scale directly beneath the notch on the LTRS and FIGS push bars, alternately, and push horizontally at right angles to the bar. A push of 3 to 5 ounces is required to start either push bar moving.

c. ADJUSTMENT. If either push-bar spring fails to meet requirements, replace the respective push-bar spring.

301. Line-Feed and Paper-Feed Mechanisms

a. The line-feed mechanism tests and adjustments are described in paragraphs 303 through 314. For a description of the line-feed sequence of operations, see paragraph 104.

b. The paper-feed mechanism tests and adjustments are described in paragraphs 315 through 324.

c. Location (right or left) directions are with respect to the front of the typing unit.

d. Experience in making tests and adjustments indicates that the most logical and efficient sequence for making tests and adjustments of the line-feed and paper-feed mechanisms is the order in which the procedures are presented in the following paragraphs. A change in any one of a chain of adjustments requires that all related adjustments be checked.

302. Platen Shaft
(fig. 250)

Before testing the platen shaft for end play, be sure that the three screws on the right end of the platen are securely seated into the shaft.

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. The platen shaft should have some end play, not more than 0.004 inch.

c. ADJUSTMENT. Position the friction assembly on the platen shaft by loosening the friction assembly setscrews and moving the friction assembly as required. Tighten the setscrews.

303. Single-Double Line-Feed Detent
(fig. 232)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. When the single-double line-feed lever is shifted from the single to the double line-feed position, or vice versa, the hump on the detent spring should travel equally on either side of the detent.

c. ADJUSTMENT. Position the detent by loosening its mounting screw and moving the detent as required. Tighten the mounting screw.

304. Single-Double Line-Feed Detent Spring Pressure
(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the single-double line-feed lever in the single line-feed position (up), hook a 12-pound scale, held in a horizontal position, over the extension of the lever and pull toward the front. A pull of 1¼ to 3¼ pounds is required to move the lever to the double line-feed position.

c. Adjustment. If the single-double line-feed detent spring fails to meet requirements, replace with a new spring.

305. Line-Feed Detent Lever

a. Preparation. The typing unit may be on or off the base.

b. Requirements (fig. 232). With the single-double line-feed lever in the single line-feed position (up) and the line-feed bail operated by hand, the line-feed pawl, when sliding off the rear edge of the single-double line-feed lever, should just miss the edge of a tooth on the line-feed ratchet.

c. Adjustment (fig. 236). Loosen the detent-lever eccentric-screw nut and turn the eccentric screw so as to rotate the platen, by means of the detent lever, to obtain the requirement. Tighten the detent-lever eccentric-screw nut and check the adjustment for all the teeth on the line-feed ratchet. There are two positions of the detent-lever eccentric screw which will provide correct adjustment. Use the position which applies the least tension to the detent-lever spring, and be sure that the detent roller rests in the bottom of a notch on the detent ratchet.

306. Line-Feed Link Turnbuckle
(fig. 232)

a. Preparation. The typing unit is removed from the base.

b. Requirements. With the single-double line-feed lever in the single line-feed position, select the LINE FEED combination and rotate the main shaft until the line-feed push bar is being stripped from the function-bail blade. Under this condition, the platen should rotate one line space, the detent roller should rest in the hollow between two ratchet teeth, and there should be some clearance, not more than 0.015 inch, between the line-feed pawl and the front face of a tooth on the ratchet. Check each tooth on the ratchet for this clearance. When gaging clearances, the play in the line-feed mechanism should be taken up in a direction to make the clearance a maximum by pressing forward on the line-feed pawl.

c. Adjustment. Place the typing unit on its right side. Adjust the length of the line-feed link by means of its turnbuckle.

307. Line-Feed Push-Bar Spring Tension
(fig. 233)

a. Preparation. Place the typing unit on its right side.

b. Requirement. With the printing bail in its extreme rear position, apply the push end of an 8-ounce scale to the line-feed push bar, just to the rear of the line-feed function lever extension, and push horizontally at right angles to the bar. A push of 1½ to 2½ ounces is required to start the push bar moving.

c. Adjustment. If the line-feed push-bar spring fails to meet requirements, replace it with a new spring.

308. Line-Feed Detent-Lever Spring Tension
(fig. 236)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the typing unit in its normal upright position, hook a 12-pound scale over the head of the detent roller mounting screw and pull at right angles to the detent lever. A pull of 5 to 6 pounds is required to start the detent lever moving.

c. Adjustment. If the line-feed detent-lever spring fails to meet requirements, replace it with a new spring.

309. Line-Feed Pawl Spring Tension
(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the single-double line-feed lever in the double line-feed position and the line-feed pawl in its unoperated position, hook an 8-ounce scale under the line-feed pawl, just to the rear of the notch, and pull straight up. A pull

of 2 to 4 ounces is required to start the pawl moving.

c. Adjustment. If the line-feed pawl spring fails to meet requirements, replace it with a new spring.

310. Line-Feed Check Screw
(fig. 236)

Note. See paragraph 104 for line-feed check (stop) sequence of operations.

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Select the LINE FEED combination and rotate the main shaft. The line-feed check screw should drop in the 12th notch from the detent roller when line-feed ratchets having 33 teeth are used, and in the 14th notch when ratchets having 37 teeth are used. (When counting the notches, start with the notch just above the detent roller.) When the check screw is held in the bottom of a notch on the ratchet, there should be some clearance, not more than 0.020 inch, between the front face of the screw and the face of the tooth, at the point of minimum clearance.

c. Adjustment. Loosen the line-feed check-screw locknut and position the check screw to meet requirements. Tighten the locknut. Rotate the platen roll and check the clearance in each notch of the ratchet. If necessary, loosen the clamping nut of the line-feed check post stop screw, and back off the stop screw before making the adjustment.

311. Line-Feed Check Post Stop Screw
(fig. 236)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Hold the line-feed check post stop screw down against the crossbar casting. When the platen is rotated, the line-feed check post stop screw should clear each detent ratchet tooth by 0.015 to 0.030 inch. Check every eighth or ninth tooth on the detent ratchet.

c. Adjustment. Loosen the check post clamping nut and position the line-feed check post stop screw. Before tightening the clamping nut, make sure that the line-feed check post is against the inner side of the crossbar casting and that the end of the line-feed check-lever shaft (fig. 232) is flush with the outer surface of the casting. Tighten the clamping nut.

312. Line-Feed Check Lever
(figs. 232 and 236)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Select the LINE FEED combination and rotate the main shaft until the line-feed pawl has reached its farthest travel in rotating the platen. The line-feed pawl lever should be in contact with the check lever, and there should be some clearance, not more than 0.015 inch, between the lower edge of the line-feed check screw and the bottom of any notch in the detent ratchet.

c. Adjustment. Loosen the line-feed check-lever setscrew and position the line-feed check lever. Before tightening the setscrew, make sure that the shaft has some end play, not more than 0.004 inch. When checking the clearance between the line-feed check screw and the ratchet, take up the play of the line-feed check-lever shaft in its right bearing to obtain the maximum clearance.

313. Line-Feed Check-Lever Spring Tension
(fig. 232)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the line-feed pawl in the forward position, hook an 8-ounce scale under the head of the check-lever setscrew and pull at right angles to the setscrew. A pull of 2 to 3 ounces should be required to start the lever moving.

c. Adjustment. If the line-feed check-lever spring fails to meet requirements, replace it with a new spring.

314. Pressure Roller Release Shaft Collars
(fig. 237)

a. Preparation. The typing unit may be on or off the base.

b. Requirements.

(1) The pressure roller release shaft should have some end play, not more than 0.004 inch.

(2) With the right collar against the casting, there should be $\frac{5}{32}$ to $\frac{7}{32}$-inch clearance between the boss just to the rear of the

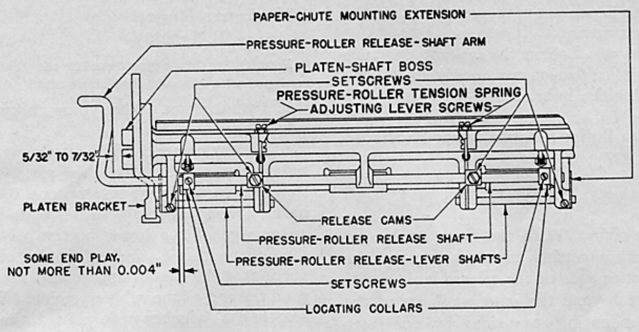


Figure 237. Pressure roller release mechanism.

platen shaft boss and the pressure roller release shaft arm when the arm is opposite the boss.

c. Adjustments.

(1) Adjust the end play by moving the left collar.

(2) Adjust the clearance of the pressure roller release shaft arm by moving the right collar.

315. Pressure Roller Release Cams
(fig. 238)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the pressure roller release shaft arm in its rear (with respect to the front of the typing unit) position, the high parts of both of the pressure roller release cams should rest on the high parts of their respective pressure roller release levers.

c. Adjustment. Position the cams on the release shaft by loosening the release cam setscrews and moving the cams as required. Tighten the setscrews.

316. Pressure Roller Tension Spring
(fig. 238)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the pressure roller release shaft arm in its forward position, hook a 12-pound scale over the lower end of each pressure roller tension spring adjusting lever, in turn, just above the spring, and pull in line with the spring.

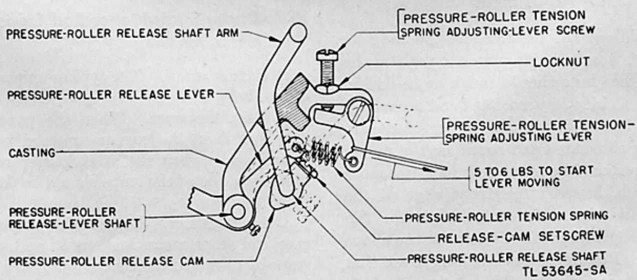


Figure 238. Pressure roller release cams and tension springs.

A pull of 5 to 6 pounds is required to start the adjusting lever moving.

c. Adjustment. Loosen the locknut and turn the pressure roller tension spring adjusting lever screw. Tighten the locknut.

317. Pressure Roller Release Lever Shafts
(fig. 237)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the inner surface of the paper chute mounting extensions against the casting, the outer ends of the release lever shafts should project beyond the outer surfaces of the paper chute mounting extensions by not more than 3/64 to 3/32 inch.

c. Adjustment. Position the release lever shafts by loosening their setscrews and moving the shafts as required. Tighten the setscrews.

318. Paper Chute Springs Tension
(B, fig. 239)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the pressure roller release shaft arm in its rear position, hook an 8-ounce scale over the rear edge of the paper chute, midway between the side frames, and pull at right angles to the rear flat surface. A pull of 2 to 4 ounces is required to start the paper chute moving.

c. Adjustment. If the paper chute springs fail to meet requirements, replace with new springs.

319. Paper Chute Adjustment

With one side of the paper chute touching its associated end boss on the platen crossbar, the other side of the chute should touch or be within 0.004 inch of touching its associated end boss; also, when one or both sides of the paper chute are touching their associated end bosses on the platen crossbar, there should be some clearance, not more than 0.020 inch, between the front edge of the paper chute and the surface of the platen. To adjust, bend the chute manually to meet the above requirements. Rotate the platen shaft to see that the paper chute does not bind the platen.

320. Paper Fingers
(B, fig. 239)

Note. Omit this adjustment if the teletypewriter is equipped with sprocket feed mechanism.

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With both paper fingers resting against the platen, the paper finger shaft stop arm should clear its stop post 0.004 to 0.020 inch. When paper 8½ inches wide is used, the outer edge of the lower portion of each finger should be within 3/32 inch of the end of the rubber portion of the platen and should not extend beyond the end of the rubber portion. When paper less than 8½ inches wide is used, the left finger should be moved inward correspondingly.

c. Ajustment. Loosen the right paper finger setscrew and position the right paper finger to provide the specified clearance between the paper finger shaft stop arm and the stop post. Tighten the setscrew. Set the left paper finger, in the same manner, to correspond to the width of the paper.

321. Paper Fingers Shaft Spring Tension
(B, fig. 239)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Hook a 32-ounce scale over the paper finger shaft stop arm, just above the stop post, and pull in line with the spring. A pull of 14 to 18 ounces should be required to start the stop arm moving.

c. Adjustment. If the paper finger shaft spring fails to meet requirements, replace it with a new spring.

322. Paper Straightener Rod Stops
(B, fig. 239)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. When the paper straightener rod is in its extreme upward position, the clearance between the straightener rod and the blocking edge of the stops should be 0.030 to 0.050 inch.

c. Adjustment. Loosen the paper straightener rod stops mounting screws and position the stops by means of their slots. Tighten the mounting screws.

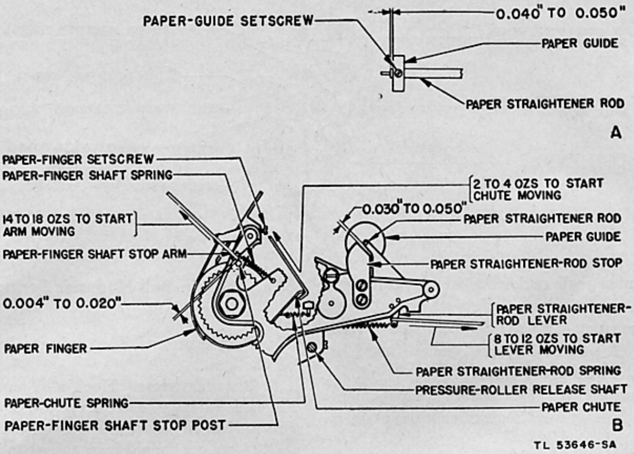


Figure 239. Paper chute, paper fingers, and paper straightener rod.

323. Paper Straightener Rod Springs Tension
(B, fig. 239)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Hook a 32-ounce scale over the ends of the paper straightener rod levers where the springs are hooked and pull in line with the springs. A pull of 8 to 12 ounces is required to start the levers moving.

c. Adjustment. If either paper straightener rod spring fails to meet requirements, replace the defective spring.

324. Paper Guides
(A, fig. 239)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. The outer side of each paper guide should be 0.040 to 0.050 inch from the shoulder on its end of the straightener rod.

c. Adjustment. Position the paper guides on the shaft by loosening the paper guide setscrews and moving the guides as required. Tighten the setscrews.

325. Spacing Escapement Pawl Operating Arm
(fig. 240)

a. Preparation. Install the typing unit on the base.

b. Requirements. Select the LINE FEED combination. Turn the governor wheel assembly counterclockwise with respect to the front of the base; this will rotate the main shaft. Rotate the main shaft by means of the governor wheel assembly until the function-lever bail rests on the line-feed function lever. There should be 0.020- to 0.040-inch clearance between the rear spacing escapement pawl and the low part of the spacing escapement ratchet.

c. Adjustment. Loosen the spacing escapement pawl operating arm mounting screws and position the arm. Tighten the mounting screws.

326. Spacing Escapement Pawl Spring Tension
(fig. 240)

a. Preparation. The typing unit is removed from the base.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position.

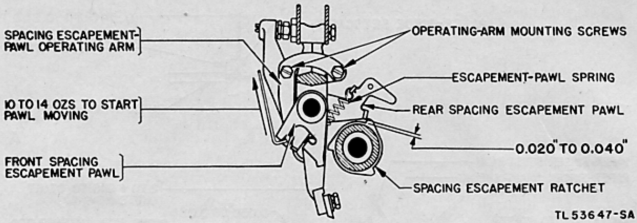


Figure 240. Spacing escapement pawls.

Hook a 32-ounce scale under the front spacing escapement pawl at the point where the pawl rests against the escapement pawl operating arm; pull straight up. A pull of 10 to 14 ounces should be required to start the pawl moving.

c. ADJUSTMENT. If the spacing escapement pawl spring fails to meet requirements, replace it with a new spring.

327. Margin-Bell Hammer
(fig. 241)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the bell hammer arm resting against the stop post, the clearance between the bell and the bell hammer should be 0.020 to 0.060 inch.

c. ADJUSTMENT. Bend the bell hammer arm along its entire length, avoiding a sharp bend at any point.

328. Margin-Bell Hammer Spring Tension
(fig. 241)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Hook a 32-ounce scale over the bell hammer arm directly below the spring and pull in line with the spring. A pull of 10½ to 13½ ounces should be required to start the arm moving.

c. ADJUSTMENT. If the margin-bell hammer spring fails to meet requirements, replace it with a new spring.

329. Signal Bell Hammer Spring Tension
(A, fig. 242)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the bell latch bar in its latched position, hook an 8-ounce scale over the upper end of the bell hammer arm extension. Pull

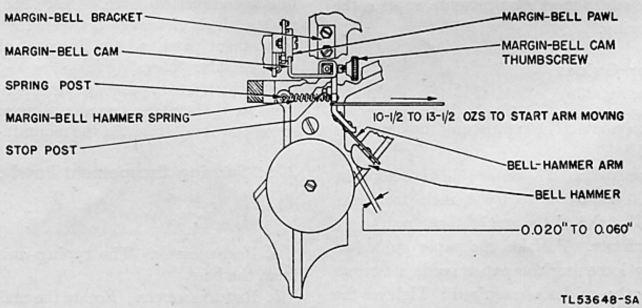


Figure 241. Margin-bell hammer.

at right angles to the inner straight edge of the extension. A pull of 3 to 5 ounces should be required to start the bell hammer moving.

c. Adjustment. Replace with a new spring if the signal bell hammer spring fails to meet requirements.

330. Signal Bell Latch-Bar Latch Shims
(A, fig. 242)

a. Preparation. Remove the typing unit from the base and place the unit on its right side.

b. Requirements. With the platen in the LTRS position (down), set up the letter S combination; rotate the main shaft until the printing bail is in its extreme forward position. When the front shoulder of the bell latch bar is fully latched on its latch, the clearance between the bell latch bar and the lobe on the rear extension of the bell function lever should be 0.004 to 0.010 inch.

c. Adjustment. Add or remove shims between the latch and the function-lever comb.

331. Signal Bell Latch-Bar Latch
(A, fig. 242)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the main shaft rotated until the function bail is in its extreme rear position, there should be a clearance of 0.010 to 0.020 inch between the front shoulder of the bell latch bar and its latch. When checking this clearance, the shoulder on the bell reset bar should be fully engaged with the function-bail blade.

c. Adjustment. Loosen the mounting screws and position the bell latch-bar latch toward the front or rear by means of its mounting slots. Tighten the mounting screws.

332. Signal Bell Hammer Backstop
(A, fig. 242)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the bell latch bar in its latched position, the clearance between the bell hammer arm extension and the bell operating lever should be 0.020 to 0.040 inch.

c. Adjustment. Loosen the mounting screws and position the backstop by means of its mounting slots. Tighten the mounting screws.

333. Signal Bell Operating-Lever Spring Tension
(A, fig. 242)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Unhook the bell reset-bar spring. With the rear shoulder of the bell latch bar resting against the bell latch-bar latch, hook a 12-pound scale under the head of the bell operating-lever screw and pull parallel to the latch bar. A pull of 1¼ to 2¼ pounds should be required to start the lever moving. Rehook the bell reset-bar spring.

c. Adjustment. Replace the spring if the signal bell operating-lever spring fails to meet requirements.

334. Signal Bell Reset-Bar Spring Tension
(B, fig. 242)

a. Preparation. The typing unit is removed from the base. Place the typing unit on its right side.

b. Requirements. Rotate the main shaft until the function bail is in its extreme forward position. With the front shoulder of the latch bar resting against the latch, hook an 8-ounce scale over the reset bar, just in front of the shoulder, and pull at right angles to the reset bar. A pull of 3 to 5 ounces should be required to start the reset bar moving.

c. Adjustment. Replace the spring if the signal bell reset-bar spring fails to meet requirements.

335. Signal Bell Function-Lever Spring Tension
(A, fig. 242)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. Select any character and rotate the main shaft until the bell function lever rests against the vanes, but is not selected. Hook a 12-pound scale over the rear extension of the bell function lever, just in front of the lobe that engages the bell latch bar, and pull at right angles to the lever. A pull of 1¾ to 2¼ pounds should be required to start the lever moving.

c. Adjustment. Replace with a new spring if the signal bell function-lever fails to meet requirements.

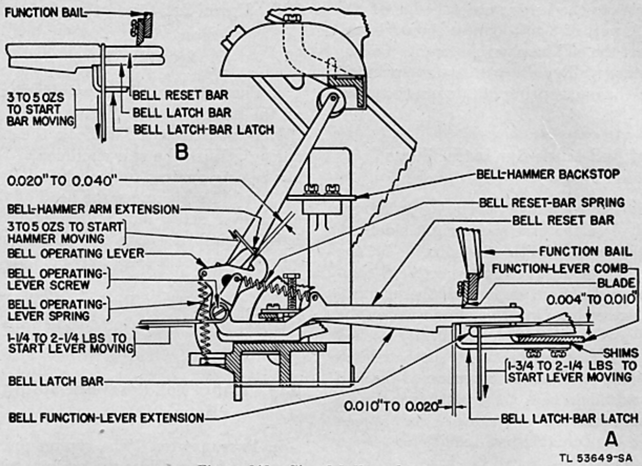


Figure 242. Signal bell mechanism.

336. Carriage-Return Latch-Bar Latch Shims (fig. 243)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the letter O combination selected and the main shaft rotated until the printing bail is in its extreme forward position, there should be 0.004- to 0.010-inch clearance between the carriage-return latch bar and the lobe on the rear extension of the carriage-return function lever. When checking this clearance, the shoulder on the carriage-return latch bar should be fully latched on the latch similar to the signal bell latch-bar latch shims adjustment (par. 330 and A, fig. 242).

c. Adjustment. Add or remove shims between the carriage-return latch-bar latch and the function-lever comb.

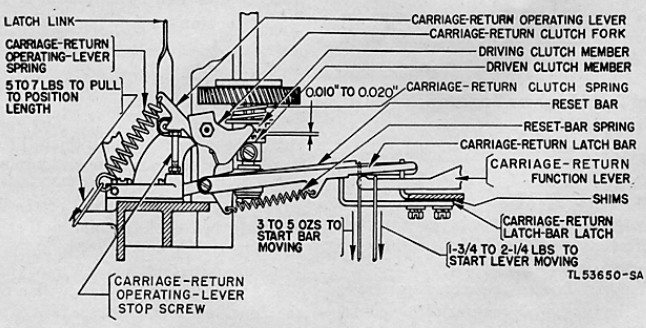


Figure 243. Carriage-return mechanism.

337. Carriage-Return Latch-Bar Latch
(fig. 243)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the main shaft rotated until the function bail is in its extreme rear position, the clearance between the shoulder on the carriage-return latch bar and the latch should be 0.010 to 0.020 inch. When checking this clearance, the shoulder on the carriage-return reset bar should be fully engaged with the function-bail blade (similar to the signal bell latch-bar adjustment) (A, fig. 242).

c. Adjustment. Loosen the mounting screws and position the latch to front or rear by means of its mounting slots. Tighten the mounting screws.

338. Carriage-Return Lock-Bar Latch Eccentric Screw
(fig. 244)

a. Preparation. The typing unit may be on or off the base, and the rear of the unit toward the operator.

b. Requirements. With the front end of the dash-pot lever held in its extreme left position, clearance between the lower edge of the carriage-return lock-bar latch and the upper edge of the lock bar should be 0.006 to 0.015 inch. When checking this clearance, take up all the play between the lock bar and the shoulder stud in a direction to make the clearance a minimum.

c. Adjustment. Adjust by means of the lock-bar latch eccentric screw. There are two positions of the lock-bar latch eccentric screw at which proper adjustment can be obtained. Use the position which gives the greater tension to the latch spring.

339. Carriage-Return Lock-Bar Latch Spring Tension
(fig. 244)

a. Preparation. The typing unit may be on or off the base, and the rear of the unit toward the operator.

b. Requirements. With the carriage-return lock-bar latch unlatched, resting on the upper part of the carriage-return lock bar, hook a 32-ounce scale over the latch, just below the spring, and pull parallel to the lock bar. A pull of 7 to 10 ounces should be required to start the latch moving.

c. Adjustment. If the carriage-return lock-bar latch spring fails to meet requirements, replace it with a new spring.

340. Carriage-Return Lock Bar
(figs. 243 and 244)

a. Preparation. Remove the typing unit from the base.

b. Requirements. With the carriage-return lock bar in its latched position and the shoulder of the lock bar held agains the edge of the latch, the clearance between the teeth of the carriage-return clutch members should be 0.010 to 0.020 inch.

c. Adjustment. To obtain the required clearance, adjust the length of the lock bar.

(1) Before adjusting the length of the lock bar, take up the play between the carriage-return clutch-driven member and its mounting screw, as follows:

(*a*) Place the typing unit on its back.

(*b*) Rotate the spacing shaft until the mounting screw of the carriage-return clutch-driven member is accessible.

(*c*) Operate the dash-pot lever to engage the clutch teeth.

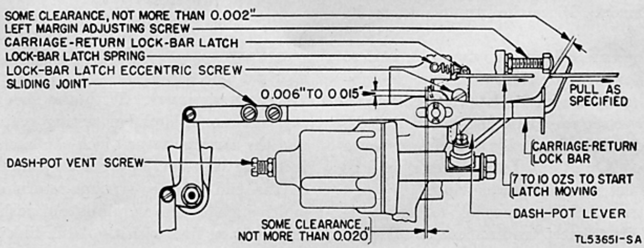


Figure 244. Lock-bar latch.

(*d*) Loosen the carriage-return clutch-driven member mounting screw. Rotate the spacing gear in a clockwise direction, as viewed from the right with respect to the front of the typing unit, until all the play between the clutch-driven member and its mounting screw has been taken up. Tighten the mounting screw.

(*e*) Place the typing unit in its normal upright position, with the rear of the unit toward the operator.

(2) Adjust the length of the lock bar by means of its sliding joint.

341. Carriage-Return Operating-Lever Stop Screw

(figs. 243 and 244).

a. Preparation. The typing unit is removed from the base.

b. Requirements. With the CAR RET combination selected and the main shaft rotated until the carriage-return function lever just trips the carriage-return latch bar off its latch, there should be some clearance, not more than 0.020 inch, between the lock-bar shoulder and the edge of the dock-bar latch. When checking this clearance, take up all the play in the lock-bar connections in a direction to make the clearance a minimum. This can be done by pulling outward on the lock bar.

c. Adjustment. Change the height of the carriage-return operating-lever stop screw.

342. Carriage-Return Reset-Bar Spring Tension

(fig. 243)

a. Preparation. Place the typing unit on its right side.

b. Requirements. Move the function bail to its extreme forward position, and trip the carriage-return latch bar off its latch. Hook an 8-ounce scale over the reset bar, just in front of the shoulder, and pull horizontally at right angles to the reset bar. A pull of 3 to 5 ounces should be required to start the reset bar moving.

c. Adjustment. If the carriage-return reset-bar spring fails to meet requirements, replace it with a new spring.

343. Carriage-Return Function-Lever Spring Tension

(fig. 243).

a. Preparation. The typing unit is resting on its right side.

b. Requirements. Select any character and rotate the main shaft until the carriage-return function lever is resting against the vanes, but not selected. Hook a 12-pound scale over the rear extension of the function lever, just in front of the lobe that engages the latch bar, and pull at right angles to the lever. A pull of 1¾ to 2¼ pounds should be required to start the function lever moving.

c. Adjustment. If the carriage-return function-lever spring fails to meet requirements, replace it with a new spring.

344. Carriage-Return Operating-Lever Spring Tension

(fig. 243)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the shoulder of the carriage-return latch bar against its latch and the carriage-return operating-lever spring unhooked from the spring post, hook a 12-pound scale in the carriage-return operating-lever spring eye. A pull of 5 to 7 pounds should be required to stretch the spring to position length. Rehook the carriage-return operating-lever spring.

c. Adjustment. If the carriage-return operating-lever spring fails to meet requirements, replace it with a new spring.

345. Carriage-Return Clutch Spring Compression

(figs. 243 and 245)

a. Preparation. The typing unit is resting on its right side.

b. Requirements. With the shoulder of the carriage-return latch bar resting against its latch and the carriage-return lock-bar latch held away from the lock bar, apply a 12-pound push scale to the end of the carriage-return clutch fork which engages the latch link, and push downward as nearly in line with the latch link as possible. A pressure of 1½ to 2½ pounds should be re-

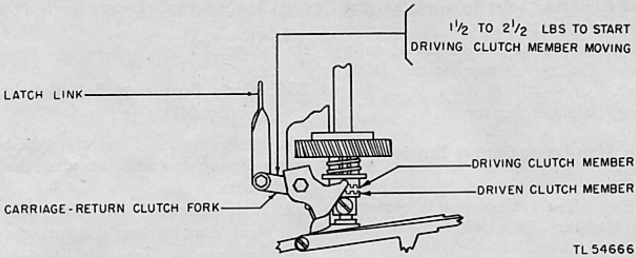


Figure 245. Carriage-return clutch spring compression.

quired to start the clutch driving member moving away from the driven member.

c. Adjustment. If the carriage-return clutch spring fails to meet requirements, replace with a new spring.

346. Dash-Pot Lever Spring Tension

(fig. 244)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Unhook the dash-pot lever spring from the spring post on the dash-pot lever, and hook a 32-ounce scale in the spring eye. With the front end of the dash-pot lever in its extreme right position, a pull of 16 to 22 ounces should be required to stretch the spring to its position length. Rehook the dash-pot lever spring.

c. Adjustment. If the dash-pot lever spring fails to meet requirements, replace it with a new spring.

347. Spacing Stop-Lever Bracket

(fig. 246)

a. Preparation. The typing unit is removed from the base; the rear of the unit is toward the operator.

b. Requirements.

(1) The lower end of the spacing stop lever should clear the driving disk of the main shaft 0.060 to 0.080 inch.

(2) With the stop lever held against the stop on the bracket by the stop-lever spring, there should be a clearance of 0.040 to 0.080 inch between the lower left edge of the stop lever and right side of a tooth on the spacing stop sleeve, when the tooth is opposite the lever.

c. Adjustments.

(1) Loosen the mounting screws and move the stop-lever bracket up or down in its en-

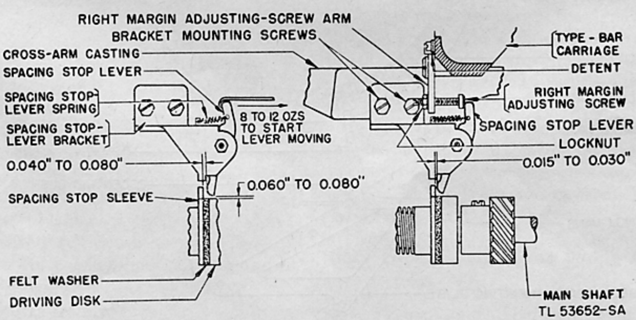


Figure 246. Spacing stop mechanism.

larged mounting holes to meet the first requirement (*b*(1) above).

(2) Move the stop-lever bracket horizontally to meet the second requirement (*b*(2) above).

(3) Tighten the mounting screw.

348. Spacing Stop-Lever Spring Tension
(fig. 246)

a. Preparation. The typing unit is removed from the base; the rear of the unit is toward the operator.

b. Requirements. Hook a 32-ounce scale over the upper end of the stop lever, and pull horizontally toward the right. A pull of 8 to 12 ounces should be required to start the lever moving.

c. Adjustment. If the spacing stop-lever spring fails to meet requirements, replace it with a new spring.

349. Carriage Guide Screws
(fig. 214)

a. Preparation. Place the type-bar carriage on the typing unit. The typing unit may be on or off the base.

b. Requirements. With the printing bail in its extreme rear position, there should be some clearance, not more than 0.008 inch, between the upper surface of the guide screwheads and the upper surface of the groove in the front carriage track. Check for this clearance along the entire travel of the carriage.

c. Adjustment. Loosen the locknuts and turn

the locknuts.

350. Code Bars and Bell Cranks
(fig. 247)

a. Preparation. Place the type-bar carriage on the typing unit and then place the typing unit on the base.

b. Requirements. Alternately select the LTRS and blank combinations and turn the main shaft until the function levers are lifted from the rear edges of the vanes. When this is done, code bars should be carried firmly against their stops in both marking and spacing positions. Select the LTRS combination, move the vanes one by one from marking to spacing position, and let the vanes return slowly to the marking position. Check any code bars which are not carried firmly against their stops. Set up the blank combination, and repeat the operation. Again check any code bars not carried firmly against their stops.

c. Adjustments.

(1) If all the code bars are carried against the stops in the spacing position and not in the marking position, or vice versa, loosen the mounting screws and move the bell crank mounting plate up or down. Moving the plate up will cause the bars to move farther toward the left (toward the marking position).

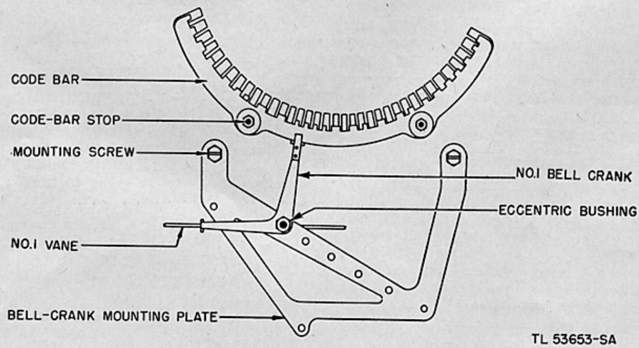


Figure 247. Code bar and bell crank.

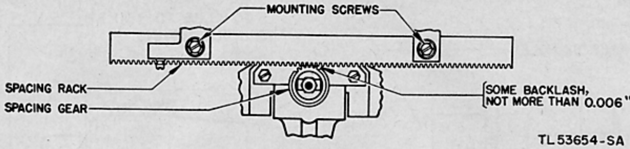


Figure 248. Spacing rack.

(2) If only one or two code bars fail to be carried firmly against their stops in both marking and spacing positions, correct the travel of the code bars by turning the bell crank eccentric bushings.

(3) Make sure that the upper ends of the bell cranks do not engage the code bars deeply enough to bind.

351. Spacing Rack
(fig. 248)

a. Preparation. The type-bar carriage is in place on the typing unit. The typing unit may be on or off the base.

b. Requirements. There should be some backlash, not more than 0.006 inch, between the spacing gear and the spacing rack along the entire travel of the rack.

c. Adjustment. Loosen the spacing rack mounting screws and move the rack toward the front or rear of the type-bar carriage. Tighten the mounting screws.

352. Locking Function-Lever Spring
(fig. 218)

a. Preparation. The type-bar carriage is placed on the typing unit. The typing unit may be on or off the base.

b. Requirements. Turn the main shaft until the printing bail is in its extreme rear position. Unhook the locking function-lever spring from the spring plate and hold the locking function lever against its pivoting shaft. Hook a 12-pound scale in the locking function-lever spring eye. A pull of 2½ to 3⅛ pounds should be required to stretch the spring to position length. Rehook the spring.

c. Adjustment. Replace with a new spring.

353. Sixth Vane Detent Spring
(fig. 216)

a. Preparation. Remove the typing unit from the base.

b. Requirements. Hook an 8-ounce scale in the sixth vane detent spring hole and pull in line with the spring toward the rear of the typing unit. A pull of 6 to 8 ounces should be required to start the roller moving away from the sixth vane.

c. Adjustment. Replace with a new spring if requirements are not met.

354. Carriage-Return Spring Drum
(fig. 160)

a. Preparation. The typing unit may be on or off the base. The type-bar carriage must be on the typing unit.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position. Hold the carriage-return lock bar approximately in its latched position so as to disengage the carriage-return clutch teeth, and hold the dash-pot lever in its operated position. Hook a 12-pound scale over the lower part of the right ribbon-spool bracket and pull in a line parallel to the carriage track. A pull of 3¾ to 4¼ pounds should be required to start the type-bar carriage moving away from its extreme left position.

c. Adjustment. To increase the tension, wind up the carriage-return spring by turning the center shaft of the drum. To decrease the tension, operate the carriage-return drum escapement lever.

355. Paper Spindle Drag Spring Adjustment
(fig. 249)

a. Preparation. The typing unit may be on or off the base.

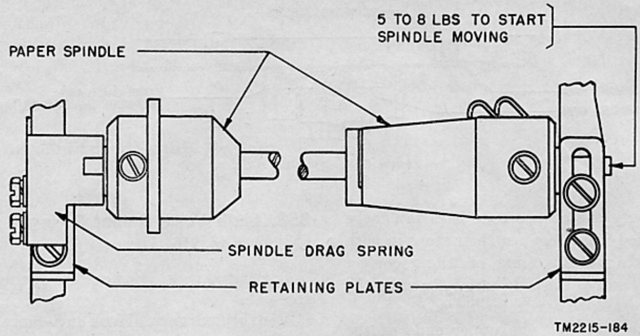


Figure 249. Paper spindle.

b. Requirements. Insert an empty paper spindle in the slots and lock the spindle in place with the retaining plates. With both ends of the spindle shaft in the bottoms of their slots, apply the push end of a 12-pound scale to the left end of the paper spindle shaft and push toward the right side of the typing unit. A pressure of 5 to 8 pounds should be required to start the spindle moving.

c. Adjustment. Bend the spindle drag spring.

356. Platen Friction Assembly
(fig. 250)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Move the pressure roller release shaft arm to its extreme rear position. Unhook the line-feed detent-lever spring, and place the platen handle straight up. Hook a 32-ounce scale at the end of the crank handle and pull horizontally toward the front of the typing unit. A pull of 5 to 9 ounces should be required to start the platen rotating. Rehook the line-feed detent-lever spring.

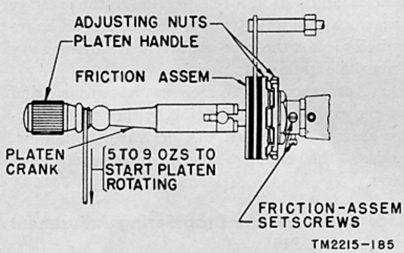


Figure 250. Platen friction assembly.

c. Adjustment. Increase or decrease the amount of friction by turning the adjusting nuts on the friction assembly.

357. Send-Receive T Lever Friction Washer
(A, fig. 251)

a. Preparation. The typing unit is removed from the base.

b. Requirements. With the printing bail in its extreme rear position, move the T lever so that the clearance between the T lever and the universal function-lever extension is 0.040 to 0.060 inch. Hook an 8-ounce scale under the right extension of the T lever, just to the left of the universal function-lever extension, and pull straight up. A pull of 5 to 6½ ounces should be required to start the lever moving.

c. Adjustment. If requirements are not met, replace the friction washer.

Note. The above adjustment applies only to old style units which do not have the elastic stop nut. On units equipped with the 119925 elastic stop nut and 71047 shim in place of the 3598 nut and 2191 lockwasher, the friction requirement of 5 to 6½ ounces may be obtained by adjusting the position of the stop nut.

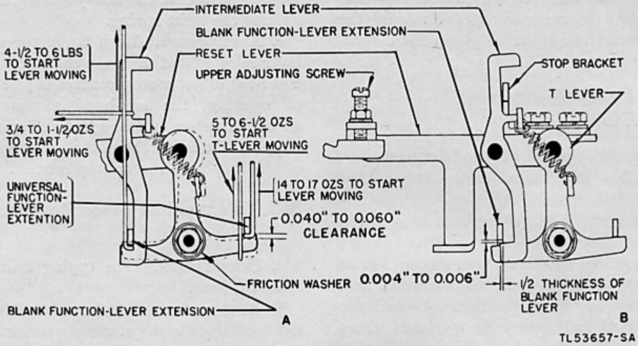


Figure 251. Intermediate lever.

358. Universal Function-Lever Spring Tension
(A, fig. 251)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the printing bail in its extreme rear position, hook a 32-ounce scale under the extreme front end of the universal function-lever extension and pull straight up. A pull of 14 to 17 ounces should be required to start the lever moving.

c. Adjustment. If the universal function-lever spring fails to meet requirements, replace it with a new spring.

359. Blank Function-Lever Spring Tension
(A, fig. 251)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the printing bail in its extreme rear position, hook a 12-pound scale under the extreme front end of the blank function-lever extension and pull straight up. A pull of 4½ to 6 pounds should be required to start the lever moving.

c. Adjustment. If the blank function-lever spring fails to meet requirements, replace with a new spring.

360. Send-Receive Mechanism Plate
(fig. 228)

a. Preparation. The typing unit is removed from the base.

b. Requirements.

(1) Select the blank combination. Rotate the main shaft until the blank function lever is completely selected. Stop rotating the shaft at the point where the function-lever bail roller just leaves the cam surface of the blank function lever. Under these conditions and with the left arm of the T lever in contact with the blank function-lever extension, there should be some clearance, not more than 0.008 inch, between the right arm of the T lever and the universal function-lever extension.

Note. When setting up the above conditions on typing units equipped with a blank printing and spacing cut-out function lever, stop rotating the main shaft at the point where the function-lever bail comes to rest on top of the blank printing and spacing cut-out function lever.

(2) On typing units from which the blank and universal function levers are omitted, the vertical clearance between both ends of the function-lever spring plate and the send-receive mechanism plate should be 0.020 to 0.030 inch.

c. Adjustment. Make sure that the intermediate lever is clear of the function-lever extension.

Then position the send-receive mechanism plate by loosening the mounting screws and moving the plate in its mounting slots. Tighten the mounting screws.

361. Right Motor-Stop Contacts
(figs. 227 and 228)

This adjustment applies only to teletypewriters equipped with a mechanical motor-stop mechanism.

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, the selector armature held in the marking (operated) position, and the inner motor-stop pawl engaged with its latch, there should be a slight clearance, not more than 0.006 inch, between the insulated end of the light contact spring of the right motor-stop contacts and the upper end of the motor-stop contact lever.

c. ADJUSTMENT. To adjust, position the right contact spring bracket by means of its mounting holes so that the contact spring mounting surface of the bracket is approximately parallel to the top edge of the send-receive mechanism plate. Then bend the light contact spring, if necessary, to obtain the required clearance. Make certain that the heavy contact spring does not bear against the light spring. With the selector armature in the spacing (unoperated) position, and the outer motor-stop pawl engaged with the latch, there should be a clearance of 0.015 to 0.020 inch between the contact points. To adjust, bend the heavy spring of the right motor-stop contacts.

362. Left Motor-Stop Contacts
(fig. 228)

This adjustment applies only to teletypewriters equipped with a mechanical motor-stop mechanism.

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, there should be some clearance, not more than 0.006 inch, between the insulated end of the contact spring of the left motor-stop contacts and the lobe on the front extension of the motor-stop function lever. To adjust, bend the light contact spring to obtain the clearance, making sure that the heavy spring does not bear against the light spring.

c. ADJUSTMENT. With the motor-stop function lever selected and the main shaft rotated until the right-hand motor-stop contact is just at the point of opening, the left-hand motor-stop contact should just close as the right-hand contact is about to open. To adjust, bend the heavy contact spring of the left-hand motor-stop contact.

363. Intermediate Lever Stop Bracket
(fig. 228)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. Select the blank combination and rotate the main shaft until the intermediate lever toe is under the blank function-lever extension. Make sure that the intermediate lever is approximately vertical. Then select the T combination and rotate the main shaft until the printing bail is in its extreme forward position. During this last operation, the left end of the intermediate lever toe should move to a point at least $1/16$ inch to the right of the blank function-lever extension.

c. ADJUSTMENT. Position the intermediate lever stop bracket by means of its mounting slots.

364. Intermediate Lever Spring Tension
(A, fig. 251)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, move the T lever so that its right end is in contact with the universal function-lever extension; hold the reset lever so that its upper edge is horizontal. Hook an 8-ounce scale over the intermediate lever, just above the spring arm, and pull horizontally toward the left of the typing unit. A pull of $3/4$ to $1\frac{1}{2}$ ounces should be required to start the lever moving.

c. ADJUSTMENT. If the intermediate lever spring fails to meet requirements, replace it with a new spring.

365. Motor Plate
(fig. 252)

a. PREPARATION. The typing unit is in place on the base. Remove the keyboard.

b. Requirements.

(1) Face the front of the base unit and visually check the alinement of the main-shaft gear and the motor pinion. The alinement of the gear and pinion should be such that a line through the center of the gear coincides with a line through the vertical diameter of the pinion (fig. 190)

(2) There should be a barely perceptible amount of backlash between the motor pinion and the highest point on the main shaft gear.

c. Adjustments.

(1) To adjust the alinement of the main-shaft gear and motor pinion, proceed as follows, for motors not having elongated mounting holes:

(*a*) Remove the typing unit from the teletypewriter base.

(*b*) Loosen the four motor mounting screws.

(*c*) Replace the typing unit on the teletypewriter base.

(*d*) Shift the motor by taking up the play between the drilled motor mounting holes and the motor mounting screws until the center lines of the gear and pinion coincide as described in *b*(1) above. If there is insufficient play in the motor mounting holes to permit the motor to be shifted sufficiently to provide proper alinement, loosen the three motor plate mounting screws and shift the motor to obtain the best possible alinement of the main-shaft gear and motor pinion. Tighten the motor plate mounting screws.

(*e*) See that the edges of the motor base are parallel to the respective edges of the motor plate.

(*f*) Remove the typing unit.

(*g*) Tighten the four motor mounting screws.

(2) For motor *having* elongated mounting holes, the adjustment procedure will be the same except that in the usual case the elongated mounting holes will permit sufficient play to provide proper alinement of the gear and pinion, and it will be unnecessary to use the motor plate mounting screws as an aid in obtaining an alinement. To correct the amount of backlash, proceed as follows:

(*a*) Loosen the rear motor plate mounting screw and the locknut on the motor plate adjusting screw. Slightly loosen the two front motor plate mounting screws to prevent stripping the threads while making the adjustment.

(*b*) Replace the typing unit and tighten the three typing unit mounting screws.

(*c*) By means of the motor plate adjusting screw, adjust the vertical position of the motor pinion until there is a barely perceptible amount of backlash between the motor pinion and the highest point on the main-shaft gear. The highest point may be found by rotating the main shaft for one complete revolution.

(*d*) Start the motor and carefully readjust the vertical position of the motor pinion by means of the adjusting screw until the gear noise is reduced to a minimum.

(*e*) Tighten the three motor plate mounting screws and the adjusting screw locknut. Recheck the backlash between the gears. Be careful in adjusting the vertical position of the motor pinion while the motor is running, to avoid damaging the main-shaft gear and reducing the speed of or overloading the motor as the result of too close a mesh between the gear and the pinion.

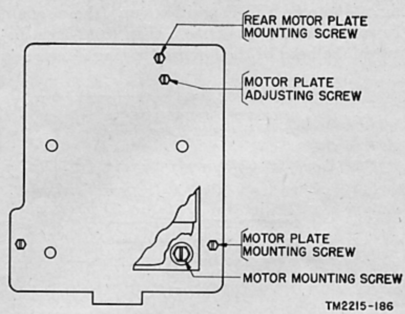


Figure 252. Motor plate.

366. Send-Receive Reset Lever Upper Adjusting Screw

(B, fig. 251)

a. Preparation. Install the typing unit on the base.

b. Requirements. There should be 0.004- to 0.006-inch clearance between the upper edge of the intermediate lever toe and the bottom of the blank function-lever extension when the printing bail is in its extreme rear position, the send-receive lever is in the SEND (up) position, and the toe of the intermediate lever is moved under the blank function-lever extension. Select the T combination and rotate the motor until the intermediate lever is moved to a position where the blank function-lever extension overlaps the toe of the intermediate lever by one-half the thickness of the blank function-lever extension.

c. Adjustment. Raise or lower the reset lever upper adjusting screw to obtain the required clearance.

367. Send-Receive Reset Lever Lower Adjusting Screw

(A, fig. 253)

Omit this adjustment when the typing unit is not equipped with a mechanical motor-stop merchanism.

a. Preparation. The typing unit is in place on the base.

b. Requirements. Place the platen in the LTRS position (down). Select the STOP combination. Rotate the motor until the printing bail is in its extreme forward position. Under these conditions and with the send-receive level (A, fig. 253) in the SEND position (up), there should be some clearance, not more than 0.002-inch, between the head of the lower adjusting screws and the lower surface of the front extension of the motor-stop function lever.

c. Adjustment. Raise or lower the reset level lower adjusting screw to obtain the required clearance.

368. Send-Receive Reset Lever Down-Stop Screw

(A, fig. 253)

a. Preparation. The typing unit is in place on the base.

b. Requirements. With the send-receive lever in the SEND position (up) and the toe of the intermediate lever under the blank function-lever extension, select the blank combination and rotate the main shaft until the function-lever bail roller just leaves the cam surface of the blank function lever. Depress the break key and immediately release it. The stop-lever plate should just latch the upper contact lever. On bases equipped with a send-receive-break mechanism having two lower contacts, the safety pawl should latch the operating lever. There should not be more than 0.002-inch clearance between the stop-lever plate and the upper contact lever or between the safety pawl and the operating lever on bases equipped with a send-receive-break mechanism having two lower contacts.

c. Adjustment. Raise or lower the reset lever down-stop screw.

369. Left Margin Adjusting Screw

(fig. 244)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. The left edge of the letter M should print $\frac{7}{8}$ inch, plus or minus $\frac{1}{16}$ inch, from the left edge of the platen, when used as the

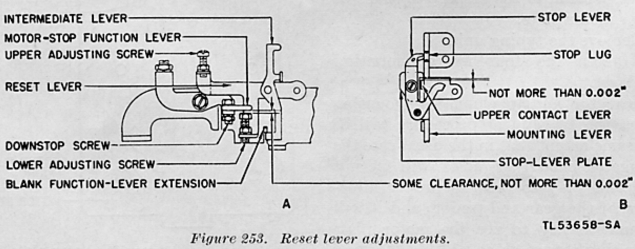


Figure 253. Reset lever adjustments.

first character in lines of 72-character length. When lines of 76-character length are required or when adjusting typing units that print 6 characters to the inch instead of the standard 10, the left edge of the letter M should print $^{11}/_{16}$ inch, plus or minus $^{1}/_{16}$ inch, from the left edge of the platen.

c. Adjustment. To adjust, turn the left margin adjusting screw inward and lock the carriage in place by operating the dash-pot lever so that the carriage will be in a position to print the letter M the required distance from the left edge of the platen. Make sure that the carriage clutch members are fully engaged. Then reposition the adjusting screw so that when the locknut is slightly tightened to take up end play in the threads and a horizontal pull of 8 pounds is exerted on the dash-pot lever, there is a slight clearance, not more than 0.002 inch, between the end of the screw and the dash-pot lever. The horizontal pull can be applied with a 12-pound scale at right angles to the curved surface, $^{1}/_{32}$ inch behind the margin and adjusting screw. Turn the left margin adjusting screw one-sixth turn in a direction to eliminate this clearance and tighten the locknut.

370. Right Margin Adjusting Screw
(fig. 246)

a. Preparation. Install the type-bar carriage on the typing unit and the typing unit on the base.

b. Requirements. The teletypewriter normally should print 72 characters on a line (44 characters for typing units that print 6 characters to the inch instead of the standard 10) before spacing is blocked by the spacing stop pawl.

c. Adjustment. Return the carriage to the left end of the line and back off the right margin adjusting screw. Then, with the right margin adjusting screw arm in engagement with its detent, space the carriage one space less than the number of characters desired per line; that is, 71 spaces for normal lines of 72 characters. The carriage should then be in position to print the last character for the desired length of line. Adjust the stop screw so that the spacing stop lever is moved within 0.015 inch to 0.030 inch from a projection on the spacing stop sleeve. When printing 72, 76, or 44 characters per line, pile-ups should occur on the 73d, 77th, and 45th characters, respectively.

371. Ribbon-Oscillator Lever
(fig. 254)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. With the ribbon lock-out bar in its unoperated position (pulled out toward the right), the ribbon should cover fully any character as it is being printed. When the printing has been completed and the main-shaft clutch has disengaged, the top edge of the ribbon should not be above the bottom edge of the printed character.

c. Adjustment. Shift the platen to the FIGS position (up), and loosen the ribbon-oscillator lever clamping screw and nut. Position the ribbon-oscillator lever, and tighten the clamping screw and nut. Check this adjustment with the platen in the LTRS position (down).

372. Ribbon Lock-Out Bar
(fig. 255)

This adjustment applies only to teletypewriters equipped with the adjustable ribbon lock-out bar.

a. Preparation. Remove the typing unit from the base.

b. Requirements. Hold the ribbon carrier down, and move the ribbon lock-out bar to the left against its stop. The ribbon should be locked far enough below the printing line to prevent printing any portion of the characters.

c. Adjustment. Remove the ribbon, ribbon carrier, and type-bar guide from the adapter plate, and loosen the ribbon lock-out-bar adjusting screws. Move the platen to the FIGS position. Hold the ribbon oscillator down, and move the ribbon lock-out bar to the left against the

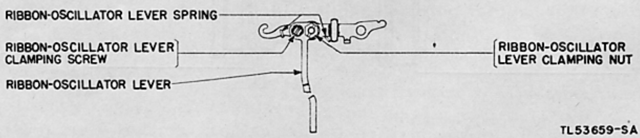


Figure 254. Ribbon-oscillator lever.

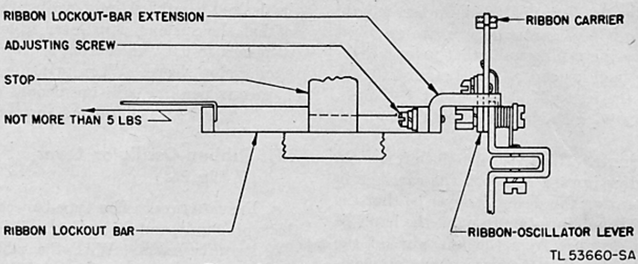


Figure 255. Ribbon lock-out bar.

stop; the lock-out-bar extension slides over the top of the ribbon oscillator. Push the lock-out-bar extension down so that the ribbon-oscillator extension is held firmly against the type-bar guide adapter plate. Hold the right end of the ribbon lock-out bar down, and tighten the lock-out-bar adjusting screws. Replace the type-bar guide, the ribbon carrier, and the ribbon. With the ribbon lock-out bar in its operated position, hook a 12-pound scale over the end of the ribbon lock-out bar, and pull directly in line with the bar. A pull of not more than 5 pounds should be required to move the lock-out bar to its unoperated position.

373. Spacing Clutch Torque
(fig. 256)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. Run the motor for at least 10 minutes. Operate the lock bar. Hook a 32-ounce scale at the bottom of the uppermost projection on the spacing-stop sleeve. Pull horizontally toward the rear of the typing unit until the leading edge of the spacing-stop sleeve is approximately vertical. With the main shaft turning, a pull of 18 to 24 ounces should be required to hold the spacing-stop sleeve stationary.

c. Adjustment. Saturate the felt washer with proper lubricating oil and recheck the requirement (*b* above). If the requirement is not met, replace the spacing clutch spring with a new spring.

374. Margin Signal Bell
(fig. 241)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. The bell should ring on the 66th printed character for lines of 72-character length, on the 70th printed character for lines of 76-character length, and on the 39th printed character for lines of 44-character length.

c. Adjustment. Return the carriage to the left

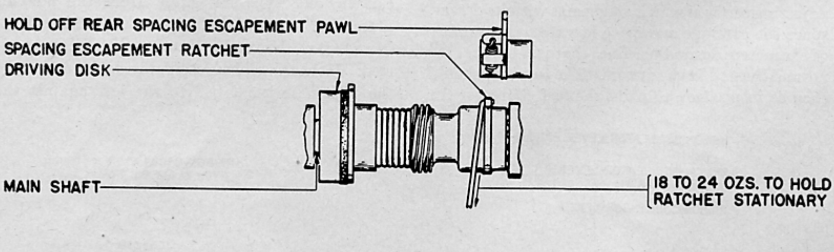


Figure 256. Main-shaft spacing clutch.

end of the line. Then space the carriage 66, 70, or 39 spaces to the right, depending on the length of line being printed. Loosen the margin bell cam thumbscrew and adjust the cam so that its right side is in contact with the margin bell pawl; tighten the thumbscrew (fig. 241).

375. Selector Clutch Torque
(fig. 257)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. Run the motor for at least 10 minutes. Hook a 32-ounce scale to the selector-cam sleeve stop arm. A pull of 14 to 18 ounces should be required to hold the sleeve stationary.

c. Adjustment. Saturate the felt washers with the proper lubricating oil and recheck the requirement (*b* above). If the requirement is not met, replace the cam-sleeve spring with a new spring or refer to (1) and (2) below.

(2) On units equipped with the 72515 nut and the 72517 keyed nut, the selector clutch torque may be adjusted by the use of shims which may be placed between the clutch spring and the 72515 nut. Remove the selector clutch spring from the shaft to apply the shims. Shims are available under the following numbers:

96763 shim (0.012-inch thick)
96764 shim (0.016-inch thick)
96765 shim (0.020-inch thick)

376. Bail-Cam Unit Friction Clutch Torque
(fig. 257)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. Remove the function-bail spring, and hold the printing bail away from its adjusting screw. With the teletypewriter running on a closed line (selector magnet ener-

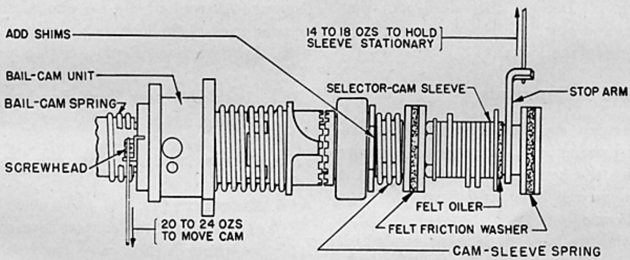


Figure 257. Bail-cam and selector-cam friction clutch.

(1) A more convenient method of regulating the selector clutch torque has been devised by the substitution of a 119540 keyed nut and a 119541 capstan nut for the 72515 nut and the 72517 keyed nut on the main shaft. When these new parts are present, the torque may be regulated by rotating the capstan nut in the proper direction (fig. 258). When adjusting the clutch torque, a minimum of 0.010-inch clearance must be maintained between the capstan nut and the ball bearing to prevent the nut from locking against the outer race.

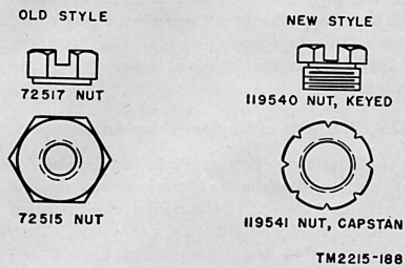


Figure 258. Selector clutch torque nuts.

gized or selector armature held in marking position by a toothpick to simulate a closed line), hook a 32-ounce scale over the screwhead on the cam unit and pull horizontally at right angles to the main shaft. A pull of 20 to 24 ounces should be required to move the cam in a direction opposite its normal direction of rotation.

c. Adjustment. Saturate the felt washer with the proper power lubricating oil and recheck the requirement (*b* above). If the requirement is not met, replace the bail-cam spring with a new spring.

377. Dash-Pot Vent Screw
(fig. 244)

a. Preparation. The type-bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. When the carriage-return lock bar is held in its latched position, the carriage should return from its right margin stop to its left margin stop without bouncing and with minimum shock.

c. Adjustment. Loosen the dash-pot vent screw locknut, and turn the screw in or out as required. Tighten the locknut.

378. Keyboard Adjustments

Unless otherwise specified, tests and adjustments given in paragraphs 379 through 398 are performed with the keyboard removed from the base. To remove the keyboard from the base, proceed as follows:

a. Loosen the two knurled thumbscrews which secure the keyboard to the base.

b. Grasp the front part of the keyboard frame and pull straight out to the front. When returning the keyboard to position on the base, be sure the lock-loop roller is resting against the lock-loop cam. If the lock-loop roller is hanging down, the roller will bar the keyboard from sliding into position.

379. Positions of Keyboard for Adjusting

a. Adjustments in paragraphs 380 through 386 are performed on the top of the keyboard, and the keyboard is placed in its normal upright position when these adjustments are performed. Turn the keyboard on its back to perform the tests and adjustments described in paragraph 387.

b. The tests and adjustments in paragraphs 378 through 383 are preliminary to the other keyboard adjustments and must precede the tests and adjustments which follow. The tests and adjustments described in paragraphs 378 through 398 are interdependent. The only way in which requirements can be met is to perform these tests and adjustments in the order in which the paragraphs are presented in this text. A change in any one of a chain of adjustments requires that all related adjustments be checked.

380. Lock-Loop Spring
(fig. 259)

a. Preparation. Remove the keyboard from the base (par. 378).

b. Requirements. Rotate the transmitting cam sleeve until the lock-loop roller rests on the low part of its cam. Hook an 8-ounce scale in the lock-loop spring hole and pull in line with the spring. A pull of 4 to 5 ounces should be required to start the lock loop moving.

c. Adjustment. Replace with a new spring.

381. Locking Lever Shaft Bracket
(fig. 259)

a. Preparation. Remove the keyboard from the base.

b. Requirements.

(1) With all the contact levers on the high parts of their cams, there should be some clearance, not more than 0.010 inch, between the contact levers and the locking levers. When measuring this clearance, press the locking levers down by hand to make minimum clearance.

(2) When the LTRS and blank keys are depressed alternately, the locking levers should travel the same distance on either side of the lock-loop blade.

c. Adjustment. Loosen the locking lever shaft mounting screws and add or remove shims between the locking lever shaft bracket and the keyboard casting to meet the first requirement (*b*(1) above). Before tightening the bracket mounting screws, position the bracket from side to side to meet the second requirement (*b*(2) above).

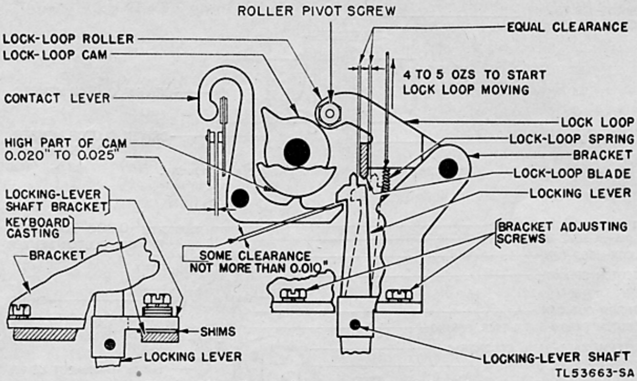


Figure 259. Transmitter contacts and lock loop.

382. Transmitting Contact Gap
(fig. 259)

a. Preparation. Remove the keyboard from the base (par. 378).

b. Requirements. With any contact lever on the high part of its cam, the contact gap should be 0.020 to 0.025 inch. For start-stop contacts, the gap should be 0.015 to 0.025 inch.

c. Adjustment. Bend the shorter contact springs.

383. Transmitting Contact Spring Pressure
(fig. 260)

a. Preparation. Remove the keyboard from the base (par. 378).

b. Requirements. With any contact lever on the low part of its cam, apply the push end of an 8-ounce scale to each contact spring just above the contact point. A pressure of 4½ to 5½ ounces should be required to open the contact.

c. Adjustment. Bend the longer contact springs. Recheck the contact gap (par. 382).

384. Transmitting-Shaft Clutch Spring Compression
(fig. 261)

a. Preparation. Remove the keyboard from the base.

b. Requirements. Hook a 32-ounce scale to the clutch-driven member projection and pull directly in line with the shaft. A pull of 9 to 12 ounces should be required to separate the clutch teeth.

c. Adjustment. Replace with a new spring.

385. Transmitting-Shaft Clutch
(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirements. When the clutch is fully disengaged, the clearance between the clutch teeth should be 0.005 to 0.015 inch.

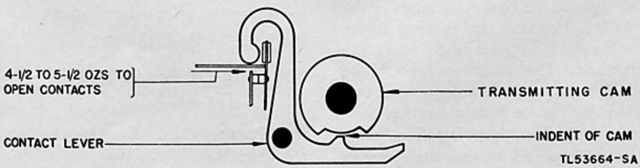


Figure 260. Transmitter contact springs.

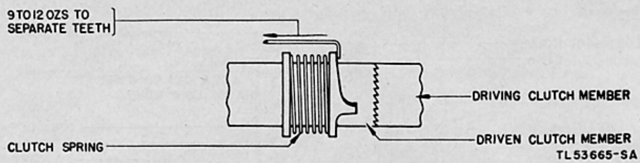


Figure 261. Transmitting-shaft clutch spring.

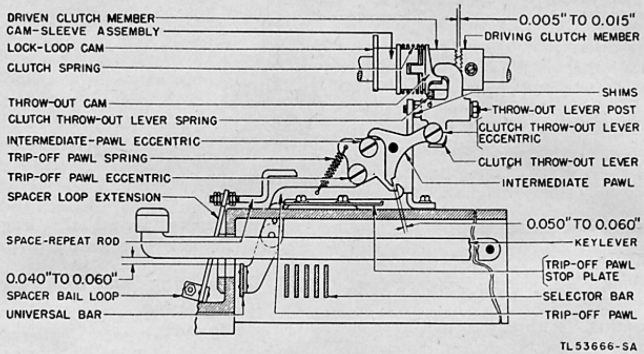


Figure 262. Transmitter clutch release mechansim.

c. Adjustment. Position the clutch throw-out lever by adding or removing shims between the throw-out lever post and the bracket.

386. Lock-Loop Roller (Adjustable)

(fig. 259)

This adjustment applies only to keyboards equipped with lock loops having slots for the roller pivot screw.

a. Preparation. Remove the keyboard from the base.

b. Requirements. Turn the keyboard shaft until the clutch teeth are disengaged. Press the lock-loop roller against its cam to disengage the clutch teeth fully. Position the locking levers directly below the lock-loop blade to make the minimum clearance. The clearance should be 0.008 to 0.015 inch between the lock-loop blade and the locking lever having the least clearance.

c. Adjustment. Position the roller pivot screw by loosening its locknut and moving the screw in the slot as required. Tighten the locknut.

387. Universal Bar Pilot Screws

(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirements. The universal bar should have some end play, not more than 0.010 inch. The universal bar extension should be approximately in the middle of the space between the P and CAR RET keylevers. Operate the trip-off pawl by depressing a keylever. The trip-off pawl should clear the sides of the stop-plate mounting screw and the locking-lever bracket.

c. Adjustment. Position the universal bar by loosening the pilot screw locknut and turning the pilot screws as required. Tighten the locknuts.

388. Trip-Off Pawl Stop Plate

(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirements. There should be 0.040-inch

to 0.060-inch clearance between all keylevers and the universal bar (0.040 inch to 0.070 inch between the spacer keylever and the universal bar) when the trip-off pawl is resting against the end of the stop plate.

c. Adjustment. To adjust, position the trip-off pawl stop plate by means of its elongated mounting holes.

389. Intermediate Pawl Eccentric
(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirements. When the trip-off pawl rests against the end of the stop plate and the intermediate pawl is against its eccentric, the clearance between the trip-off pawl and the intermediate pawl should be 0.050 to 0.060 inch.

c. Adjustment. Position the intermediate pawl eccentric by loosening the locknut and turning the eccentric screw as required. Tighten the locknut. There are two positions of the eccentric screw that give the correct clearance. Use the position where the high part of the eccentric is toward the rear of the keyboard.

390. Clutch Throw-Out Lever Eccentric
(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirements. When the clutch throw-out lever is resting on the low part of the clutch-driven member, the intermediate pawl should be held firmly between the clutch throw-out lever eccentric and the intermediate pawl eccentric.

c. Adjustment. Position the clutch throw-out lever eccentric by loosening the locknut and turning the eccentric screw as required. Tighten the locknut. There are two positions of the eccentric screw that give the correct clearance. Use the position where the high part of the eccentric is toward the rear of the keyboard.

391. Trip-Off Pawl Eccentric
(fig. 263)

a. Preparation. Remove the keyboard from the base.

b. Requirements.

(1) With the clutch throw-out lever held against the high part of its cam and the clutch throw-out lever eccentric held against the clutch throw-out lever, the end of the trip-off pawl should clear the end of the intermediate pawl by not more than 0.004 inch.

(2) With the trip-off pawl in its operated position, the clearance between the formed-up end of the stop plate and lower edge of the trip-off pawl should be at least 0.002 inch.

c. Adjustments.

(1) Loosen the locknut on the trip-off pawl eccentric screw and turn the eccentric as required. Tighten the locknut.

(2) Bend the rear extension of the trip-off pawl stop plate.

392. Clutch Throw-Out Lever Spring Tension
(fig. 262)

a. Preparation. Remove the keyboard from the base.

b. Requirement. With the clutch teeth engaged and the clutch throw-out lever resting against the low part of the clutch-driven member, hold the intermediate pawl against its eccentric. At the same time hook an 8-ounce scale over the

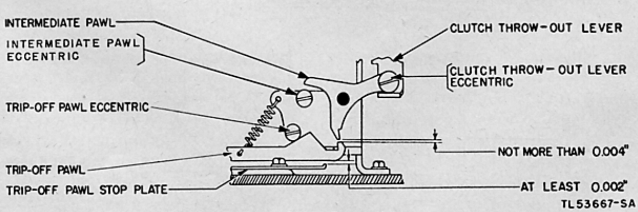


Figure 263. Trip-off eccentric screw.

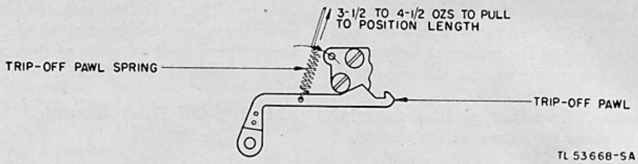


Figure 264. Trip-off pawl spring.

throw-out lever just above the spring hole and pull in line with the spring. A pull of $1\frac{1}{4}$ to $2\frac{1}{2}$ ounces should be required to start the lever moving.

c. Adjustment. Replace with a new spring.

393. Trip-Off Pawl Spring
(fig. 264)

a. Preparation. Remove the keyboard from the base.

b. Requirements. Unhook the trip-off pawl spring. Hook an 8-ounce scale in the spring eye. A pull of $3\frac{1}{2}$ to $4\frac{1}{2}$ ounces should be required to stretch the spring to position length.

c. Adjustment. Replace with a new spring.

394. Transmitting Cam Cylinder End Play
(fig. 265)

a. Preparation. Remove the keyboard from the base.

b. Requirements. The transmitting cam cylinder should have some end play, not more than 0.002 inch.

c. Adjustment. Position the bushing in the rear bearing bracket by turning its adjusting nuts.

395. Keylever Springs
(fig. 266)

a. Preparation. Remove the keyboard from the base.

b. Requirements. The openings between the ends of all keylever springs, except the spacer keylever (space-bar) spring, should measure $1\frac{3}{16}$ inches. The distance across the opening between the ends of the spacer keylever (space-bar) spring should be $1\frac{15}{16}$ inches.

c. Adjustment. Bend the springs.

396. Repeat Space Rod
(fig. 267)

a. Preparation. Remove the keyboard from the base.

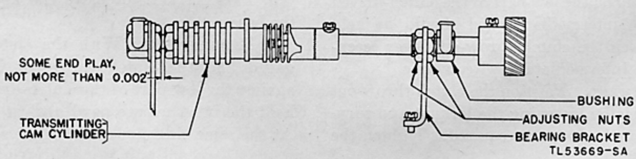


Figure 265. Transmitting shaft.

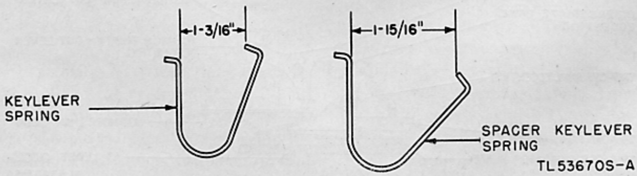


Figure 266. Keylever spring.

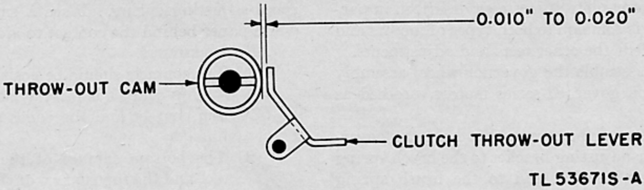


Figure 267. Clutch throw-out lever.

b. Requirements. With the space bar fully depressed by being pushed down at the center, the clearance between the clutch throw-out lever and the high part of the throw-out cam should be 0.010 to 0.020 inch.

c. Adjustment. Move the repeat space rod by turning its adjusting nuts.

397. Repeat Space Rod Bracket
(fig. 268)

This adjustment applies only to a keyboard equipped with a repeat space rod bracket having an enlarged mounting hole (0.205 inch in diameter) and a flat washer under the head of the bracket mounting screw.

a. Preparation. Remove the keyboard from the base.

b. Requirements. When the space bar is fully depressed there should be some clearance, not more than 0.008 inch, between the formed-up end of the repeat space rod and the flat side of the transmitter rear bracket throughout the entire travel of the repeat space rod. The front face of the repeat space rod bracket should be parallel to the rear face of the transmitter gear bracket.

c. Adjustment. Position the repeat space rod bracket by loosening the mounting screw and moving the bracket by means of its enlarged mounting hole. Tighten the mounting screw.

398. Repeat Space Rod Spring Tension
(fig. 268)

a. Preparation. Remove the keyboard from the base.

b. Requirements. Hook an 8-ounce scale over the repeat space rod, just in front of the spring hole, and pull it in line with the spring. A pull of 1 to 3 ounces should be required to start the rod moving.

c. Adjustment. Replace with a new spring. On continuous repeating keyboards, two 41663 washers have been added under the head of each of the two 6746 screws that mount the brace to the 7382 bracket. To convert a standard nonrepeating keyboard to a repeating keyboard that continuously repeats any character for which a key is depressed, remove these washers and place them under the 74749 stop plate (fig. 262), two at each mounting screw.

399. Motor Adjustments

a. Teletypewriter Set TT–5/FG or TT–6/FG may be equipped either with a governed-series motor or a synchronous motor.

(1) Tests and adjustments for governed-series motors are described in *c* below through paragraph 408.

(2) Tests and adjustments for synchronous motors are described in paragraph 409.

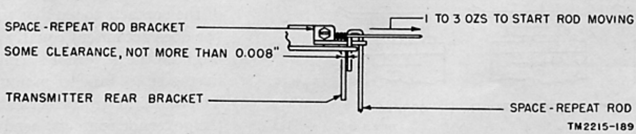


Figure 268. Repeat space rod bracket and spring.

b. The motor-plate adjustment described in paragraph 365 is common to both types of motors and should precede the other tests and adjustments.

c. To disassemble the governor wheel assembly (fig. 272) on governed-series motors, proceed as follows:

(1) Remove the screws that hold the governor-adjusting bracket to the brush spring plate bracket and to the brush spring plate, respectively. Lift off the governor-adjusting bracket.

(2) Remove the screws that hold the brush spring plate to the brush spring plate bracket. Lift the governor brush assembly off the governor shell and place the brush assembly out of the way, to the right. It will be unnecessary to disconnect the leads connecting the governor brushes to the filter.

(3) Remove screws that hold the target and governor cover to the governor shell. Remove target and governor cover.

(4) Remove the screw at the back of the governor shell, and slide the governor shell and shims off the motor shaft; note the number of shims.

d. Experience in making tests and adjustments indicates that the most logical and efficient sequence for making tests and adjustments on the motor is the order in which the procedures are presented in the following paragraphs. *A change in any one of a chain of adjustments requires that all related adjustments be checked.*

400. Governor Contact Alinement and Squareness

(fig. 269)

a. Preparation. Remove the governor-adjusting bracket, governor brush assembly, target, governor cover, and governor shell. Place the governor shell as shown in figure 270. Unhook the speed-adjusting spring. Place a small piece of white paper behind the contact to aid in viewing.

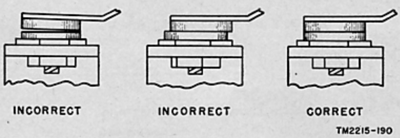


Figure 269. Governor contact alinement.

b. Requirements.

(1) The contacts should be positioned so that the top contact is directly above the bottom contact and the edges should be in line.

(2) The bottom surface of the upper contact and the top surface of the lower contact should be parallel when the contacts are touching (not touching on one side only).

(3) There should be a gap of 0.015 to 0.040 inch between the governor contacts.

(4) The surface of the contacts should be free of build-ups but may have small pits.

(5) All governor contacts can be adjusted for alinement of edges. Only those governor shells which provide elongated mounting holes for the fixed-contact bracket permit adjustment of the contact for height by positioning the contact bracket. Check with the retractile spring tension adjusted so that the contacts just make or to the limit of the adjusting screw.

c. Adjustments To position the governor contacts, proceed as follows:

(1) Loosen the two screws that hold the governor spring bracket and the two screws that hold the fixed contact bracket. These screws may be reached from the under side of the governor shell.

(2) Line up edges of contacts by means of the floating contact hinge mounting screw.

(3) Adjust contacts for squareness from right to left by positioning the height of the fixed contact bracket, using the elongated mounting holes in the governor shell.

(4) To adjust from front to back, twist the floating contact hinge, applying pressure to the arm near the contact. Check by use of a 0.002-inch gage (smaller if available). Check with gage between edges of the contacts to see that the gage enters (or does not enter) equally on all sides.

(5) Tighten the governor spring bracket and fixed-contact bracket mounting screws.

(6) To obtain the required clearance between the governor contacts, bend the governor contact spring. The end of the speed-

(6) adjusting spring post should not touch the governor shell. There must be some clearance between the shell and the end of the spring post.

(7) Rehook the speed-adjusting spring.

401. Governor Speed-Adjusting Wheel Friction Washer

(fig. 270)

a. Preparation. To check the requirements, a preliminary adjustment must be made. Remove the target and governor cover. Hook a 32-ounce scale over the contact spring near the contact and pull in line with the speed-adjusting spring. Turn the speed-adjusting wheel to the right or left until a pull of 13 to 14 ounces just separates the governor contacts.

b. Requirements. Hook a 32-ounce scale over a bank pin inserted radially in the leather of the speed-adjusting wheel and pull at right angles to the radius. A pull of 16 to 24 ounces should be required to start the wheel moving.

c. Adjustments. If the friction washer fails to meet requirements, proceed as follows:

(1) Loosen the two friction-washer mounting screws on the under side of the governor shell.

(2) Lift out the adjusting-wheel assembly.

(3) Separate the bearing assembly, upper from lower, and remove the friction washer.

(4) Bend the flat projections of the friction washer as necessary to meet requirements.

(5) Replace the bearing assembly.

(6) Replace the adjusting-wheel assembly in the governor shell, and fasten in place with the two friction-washer mounting screws.

402. Governor Inner and Outer Disk Contact Springs

(fig. 271)

a. Preparation. Remove the governor brush spring plate and the governor cover (fig. 272).

b. Requirements.

(1) The distance from the inner surface of the governor cover to the highest point on the contact springs should be 25/32 to 27/32 inch.

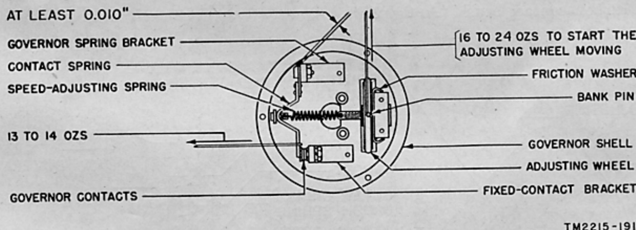


Figure 270. Governor speed-adjusting wheel.

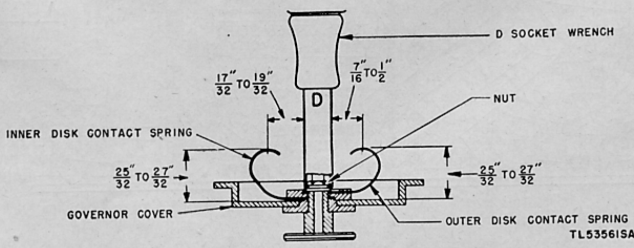


Figure 271. Governor inner and outer disk contact springs.

(2) Place a D socket wrench over the nut located in the center of the governor cover. Use a 6-inch scale to measure the radial distance from the vertical surface of the wrench to the point where the scale touches the curved surface of the inner disk contact spring. This distance should measure $^{17}/_{32}$ to $^{19}/_{32}$ inch.

(3) Measure the distance from the wrench to the point of contact on the outer disk contact spring in the same manner as described in (2) above. This distance should measure $^{7}/_{16}$ to $^{1}/_{2}$ inch.

c. Adjustment. Bend the inner and outer disk contact springs as required. Avoid any sharp bends or the springs may break. Replace the governor cover and target.

403. Governor Brush Spring Plate Bracket (fig. 272)

a. Preparation. Remount the brush spring plate if it was not remounted as part of the previous adjustment.

b. Requirements.

(1) A line through the center of the outer disk should pass through the center of each carbon contact brush (A, fig. 272).

(2) The surface of the brush spring plate bracket on which the brush spring plate is mounted should be in line with the outer surface of that part of the governor cover on which the target is mounted (B, fig. 272).

(3) The brush spring plate bracket should be parallel to the edge of the motor base plate.

c. Adjustment. Loosen the two brush spring plate bracket mounting screws and reposition the bracket. Tighten the mounting screws.

404. Governor Brush Spring Pressure (B, fig. 272)

a. Preparation. None required.

b. Requirements.

(1) Apply an 8-ounce scale to the brush springs near the carbon brush and push (or pull) horizontally in line with the armature shaft. A push (or pull) of $4\frac{1}{2}$ to $5\frac{1}{2}$ ounces should be required to start each brush moving away from its associated disk.

(2) Both carbon brushes should lie flat against their associated disks, and the

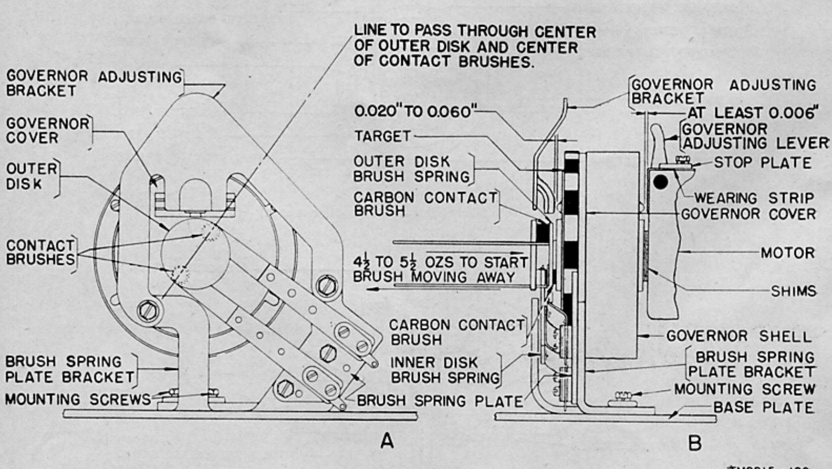


Figure 272. Governor parts and adjustments.

outer edges of the brushes should be flush with or not more than 3/64 inch inside of the outer edge of the disks.

c. Adjustment. Loosen the two brush spring clamping screws and slip the brush springs out. Bend the springs as necessary. Remount the springs and position properly. Tighten the clamping screws.

405. Governor-Adjusting Bracket

(B, fig. 272)

a. Preparation. Fasten the adjusting bracket in position with its mounting screws.

b. Requirements. The adjusting surface on the governor-adjusting bracket should clear the governor speed-adjusting wheel 0.020 to 0.060 inch.

c. Adjustment. To obtain the required clearance, bend the governor-adjusting bracket.

406. Governor-Adjusting Lever Stop Plate

(B, fig. 272)

a. Preparation. The shell must be fastened in place on the motor shaft.

b. Requirements. There should be a clearance of 0.006 to 0.050 inch between the wearing strip and the governor shell when the governor-adjusting lever is held against the stop plate.

c. Adjustment. Loosen the two stop plate mounting screws and reposition the stop plate. Tighten the mounting screws.

407. Governor Shims

(B, fig. 272)

a. Preparation. Slide the shims and governor shell on the motor shaft; fasten the shell in place with its mounting screw.

b. Requirements. With the governor-adjusting lever in its unoperated position, there should be a clearance of at least 0.006 inch between the wearing strip and the adjusting wheel when the adjusting wheel is opposite the wearing strip and all the end play of the motor armature is taken up in a direction to make the clearance a minimum.

c. Adjustment. Increase or decrease the number of shims on the armature shaft between the governor hub and the end frame casting of the motor.

408. Motor Brushes (Governed Motor)

(fig. 273)

a. Preparation.

(1) Remove the filter lead screws (one on each side of the motor).

(2) Remove the brush-holder caps, to which are attached the motor brush springs and carbon brushes. When removing the brushes, note or mark the mounting location and position of each brush so that each may be replaced in the same holder and with the same side uppermost. If the brush has a number stamped on the carbon, the number may be used as a guide.

b. Requirements. The motor brushes should be free in their holders without excessive play and should be at least 5/8 inch long, not including the brush spring or the spring mounting extension. At least one-third of the area of the ends of the brushes should be in contact with the commutator.

c. Adjustments.

(1) Replace excessively worn or damaged brushes with new brushes.

(2) If brush springs are weak, replace the brush.

(3) Use fine sandpaper to resurface the ends of the carbon brushes. Refer to paragraph 173 for one method that may be used.

d. Assembly.

(1) Replace the brush-holder caps. The cable attaching the brush to the brush-holder cap may tend to wind up, thus shortening itself. When replacing the brush, be sure that the cable on the brush is not wound up but is extended to its greatest limit.

(2) Replace the filter lead screws.

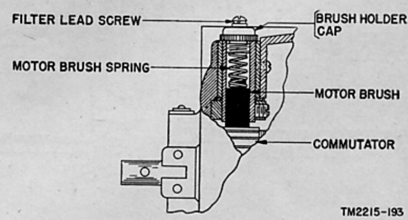


Figure 273. Governed motor brushes.

409. Synchronous Motor Adjustments

(fig. 274)

a. PREPARATION. Remove the motor from the base.

b. REQUIREMENTS. On synchronous motors with a three-brush starting switch, the switch should meet the following requirements which should not be checked unless there is reason to believe the starting switch is out of adjustment.

(1) Remove the motor unit from the base, and remove the motor fan and pinion.

(2) Remove the switch end shield screws and the switch commutator mounting screws. Remove the switch and shield.

(3) Pull out the rotor until the brush-holder spring is accessible, and remove the spring.

(4) The tension of the spring for 60-cycle motors should measure 3 to 3¾ ounces when extended to a length of 5 inches; use an 8-ounce scale. The tension of the spring for 50-cycle motors should measure 1½ to 2½ ounces when extended to a length of 5 inches; use an 8-ounce scale to test.

(5) The brush holders should be mounted by means of the center set of mounting holes and should be free.

(6) The brush-holder stop pins should be safely within the holes of the fiber disk when all the play in the brush holders has been taken up to make the engagement of the pins with the disk a minimum.

(7) Replace the brush-holder spring, making certain that the spring eyes are fully engaged with each other.

(8) Replace the switch commutator screws and tighten the two screws alternately a little at a time until both screws are tight.

c. ADJUSTMENTS. Replace worn or damaged parts.

410. Motor Unit Slip-Connector Springs

(fig. 150)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS.

(1) With the motor unit in position on the base, hook a 12-pound scale under one of

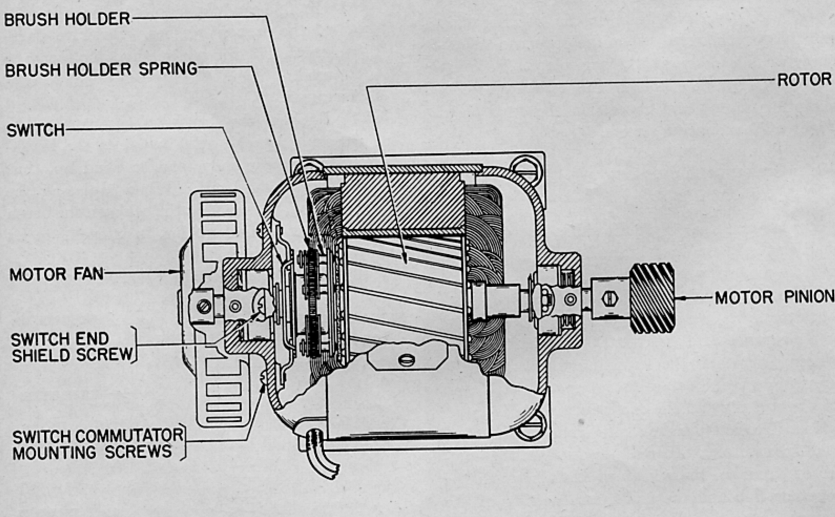


Figure 274. Synchronous motor.

the motor unit slip-connection end springs, just above the head of the terminal screw on the motor connection block. Pull toward the front of the base at right angles to the spring. A pull of 2 to 4 pounds should be required to separate the contacts. Measure the pressure of the opposite end slip-connection spring the same way.

(2) With the motor unit removed, place a straight edge across the two end springs. There should be some clearance, not more than 0.015 inch, between the two inner springs and the straight edge.

c. Adjustment. Remove the motor unit from the base, and bend the two inner springs.

411. Line Jack Springs
(fig. 150)

a. Preparation. Remove the typing unit and the keyboard from the base.

b. Requirements.

(1) Apply the push end of a 12-pound scale to the curved part of the jack spring. A pressure of 1 to 2 pounds should be required to open the contacts.

(2) Place the typing unit in position on the base. The line jack contact should be separated 0.020 to 0.060 inch.

c. Adjustment. Remove the typing unit from the base and bend the long contact spring.

412. Keyboard Jack Springs Adjustment
(fig. 150)

a. Preparation. Remove the typing unit and keyboard from the base.

b. Requirements.

(1) The two keyboard jack springs are contact Nos. 51 and 54 (from left to right, with respect to the front of the teletypewriter, the first and fourth of the keyboard slip-connection springs). Hook a 12-pound scale under the curved portion of contact Nos. 51 and 54, in turn, and pull vertically upward. It should require 1 to 2 pounds of pressure on the curved part of a keyboard jack spring to just open the contact.

(2) Insert the keyboard in the base. The keyboard jack springs should be separated 0.025 to 0.075 inch. Measure this clearance by inserting a wire gage between the contact jack springs.

(3) All keyboard slip-connection springs should be in line.

c. Adjustments. If the keyboard jack springs fail to meet requirements and must be adjusted, the bakelite sheet which covers the springs must be removed. Since the screws which hold the bakelite cover can be removed only from the under side of the equipment, it will be necessary first to remove the base plate. Upend the teletypewriter base and remove the four base-plate mounting screws from the under side of the base. Remove the base plate. With the teletypewriter base still upended, remove the four screws that hold the slip-connection mounting plate assembly to the base. Remove the bakelite cover and then replace the four slip-connection mounting plate assembly screws.

(1) Measure the pressure of the two keyboard jack springs (contact Nos. 51 and 54). To obtain the proper spring tension (*b*(1) above), bend the longer of the two jack springs.

(2) Insert the keyboard in the base. Measure the spring clearance from above the base by inserting a wire gage between the contact jack springs. With the bakelite cover removed, the keyboard jack springs should be separated 0.005 to 0.025 inch (the clearance given in *b*(2) above is with the bakelite cover in place). To obtain the proper contact gap, bend the shorter of the two jack springs.

(3) Remove the keyboard from the base and lay a straightedge across the two keyboard jack springs. Aline the other slip-connection contact springs, by bending, so that they just touch the straightedge.

(4) Upend the teletypewriter base, remove the four slip-connection mounting plate screws, insert the bakelite cover in its original position, and replace the slip-connection mounting plate screws. Install the base plate on the base by means of its mounting screws.

413. Typing Unit Slip-Connection Spring
(fig. 150)

a. Preparation. Remove the typing unit from the base.

b. Requirements. Hold a straightedge flush against the left rear milled surface on the base, and extend the straightedge over the typing unit slip connections. There should be ⅞-inch clearance (plus or minus 1/64 inch) between the straightedge and the top of the curved part of the springs.

c. Adjustment. Bend the slip-connection springs to obtain the necessary clearance.

414. Polar Line Relay Ry–30
(fig. 275)

a. Routine Inspection. Efficient operation of the Ry–28 or the Ry–30 relay in teletypewriter circuits depends upon a periodical routine of inspection, cleaning, and adjustment. The adjustments are so interrelated that it is essential for each adjustment to be made in the given sequence. If any adjustment is changed, it will be necessary to check all subsequent adjustments.

b. Preparations.

(1) Remove the relay cover and blow out any accumulated dust. Wipe the relay and cover with a clean soft cloth.

(2) Loosen both pole-piece screw locknuts (knurled tension knob on Ry–30) and back off both pole-piece screws as far as possible. Back off both contact screws.

(3) Remove pits and build-ups on the contacts with a contact file. Back out contact screws to permit entrance of contact file. When cleaning the armature contacts, the armature should be supported at its midposition by the opposite contact screw, to avoid bending the armature

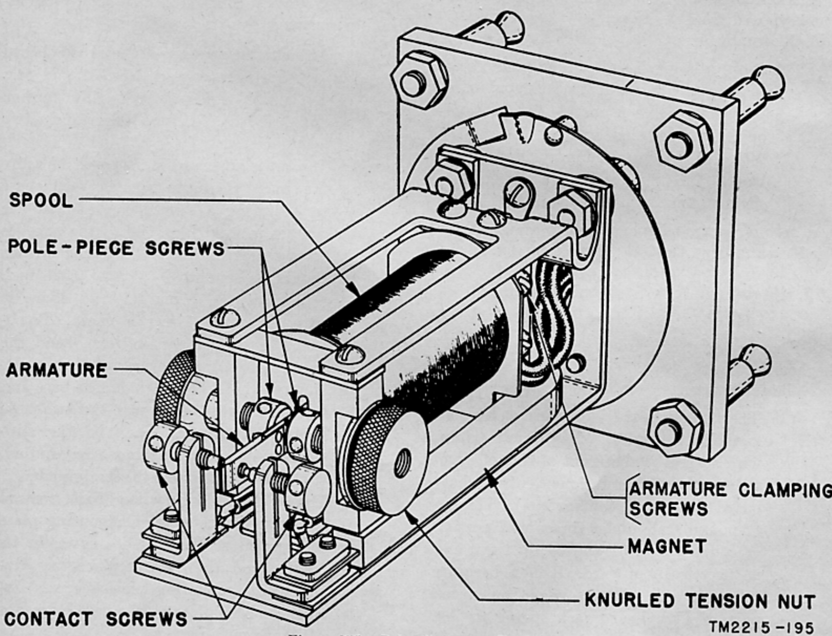


Figure 275. Polar line relay Ry–30.

or the contact springs. Be careful when filing the armature contacts to use light pressure. After using the file, blow out any loose particles and polish the contacts with a burnisher.

(4) Remove any particles adhering to the armature or pole-piece screws by pressing a fresh piece of friction tape, wrapped around a piece of thin stiff nonmagnetic metal, against the particles. Do not rub the tape against the armature or pole-piece screws as this will leave a residue which will collect further particles.

(5) Make sure that pole-piece screws and relay terminals are clean.

c. ADJUSTMENTS. Adjustments of the relay are covered in paragraphs 415 through 418.

415. Armature
(fig. 275)

a. REQUIREMENTS. The armature should not touch the inside of the spool, and the contacts should aline so that the centers of the contacts will not be out of alinement by more than 25 percent of the contact diameter.

b. ADJUSTMENTS. Loosen the screws holding the spool heads to the relay frame, and position the spool to meet the first requirement. Tighten the screws. Loosen the armature clamping screws, and position the armature both vertically and horizontally to meet the latter requirement. Tighten the screws. If necessary, position the contact screw brackets by means of the enlarged mounting holes in the relay frame to aid in meeting the latter requirement.

416. Armature Contact Springs Alinement
(fig. 275)

a. REQUIREMENTS. The armature contact springs should be parallel to the armature, and the tips of the armature contact springs should rest against each other, approximately flat across their width, with a pressure of $\frac{3}{4}$ to $1\frac{3}{4}$ ounces measured on one spring at the contact with the other spring held so that it cannot follow its mate. If necessary, back off the contact screws.

b. ADJUSTMENTS. Bend the spring toward or away from the other contact spring as required, and as close as practicable to the point where it is riveted to the armature. Reset the contact screws.

417. Contact Screw
(fig. 275)

a. REQUIREMENTS. The clearance between the armature in its normal unoperated position and either contact screw should be approximately equal, and when the armature is held against one contact screw, there should be 0.003- to 0.005-inch clearance between the armature and the other contact screw.

b. ADJUSTMENTS. Back off the pole-piece screws as far as possible, and position the contact screws to meet this requirement.

Note. The contact screws should be sufficiently tight in their brackets to hold any adjusted position. If necessary, remove the contact screw from the bracket and force the two portions of the split end of the bracket closer together to meet this requirement.

418. Pole-Piece Screws
(fig. 275)

a. REQUIREMENTS.

(1) When the armature is held, first against one contact screw and then against the other, the armature stop pins should not touch the pole-piece screws.

(2) The armature should be centered in the magnetic field between the pole-piece screws; for example, the armature should either float in the gap between the contact screws, or it should stay against either contact, with approximately the same pressure when moved there by hand.

b. ADJUSTMENTS.

(1) Back off both pole-piece screws and check the contact screw adjustment. Readjust if necessary.

(2) Advance the right pole-piece screw until, with its locknut (knurled tension knob on Ry–30 relays) tight, the right pole-piece screw pushes the armature far enough to just touch the left-hand contact screw. Back off the right pole-piece screw approximately one-fourth turn from this position until the requirement in *a*(1) above is met. Tighten the locknut.

(3) Advance the left pole-piece screw until the requirement in *a*(2) above is met. Tighten the locknut. If this disturbs the

adjustment, reposition the left pole-piece screw and retighten the locknut to meet the requirement. When adjusting the pole-piece screws on Ry–30 relays, the knurled tension nuts should be sufficiently tight to hold the pole-piece screws in the adjusted position.

419. Relay Jack Contact Gaps
(B, fig. 276)

a. Preparation. None required.

b. Requirements.

(1) When the jack plunger is held flush with the relay connection block mounting plate, there should be a gap of 0.010 to 0.015 inch between the contact points of contact springs Nos. 3 and 4.

(2) When the jack plunger is held flush with the relay connection block mounting plate, there should be .020- to .025-inch clearance between the contact points of Nos. 1 and 2.

c. Adjustment.

(1) Bend contact spring No. 3 (*b*(1) above).
(2) Bend contact spring No. 2 (*b*(2) above).

420. Relay Jack Contact Springs
(A, fig. 276)

a. Preparation. None required.

b. Requirements. When an 8-ounce scale is hooked to contact spring No. 1 or No. 4 at right angles to the springs, it should require a pull of 5 to 7 ounces to separate the contact points of contact springs Nos. 1 and 2 or of contact springs Nos. 3 and 4, respectively.

c. Adjustment. Bend contact springs Nos. 1 and 4.

421. Send-Receive Stop-Lever Plate
(A, fig. 277)

a. Preparation. Remove typing unit from the base.

b. Requirements. Hold the left end of the upper contact lever up against the stop lug on the send-receive stop-lever plate. There should be 0.004- to 0.015-inch clearance between the shoulder in the notch in the upper contact lever and the top of the lower contact lever.

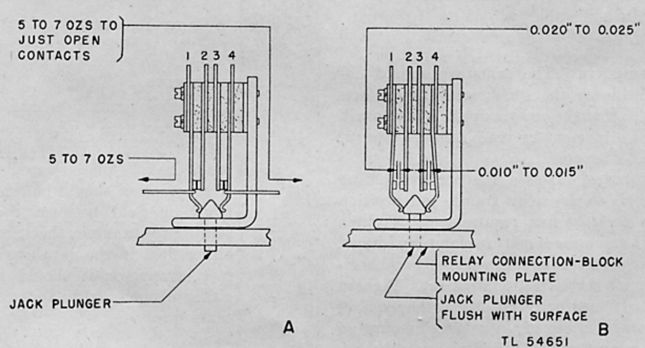


Figure 276. Relay jack contact springs and gaps.

c. Adjustment. Position the send-receive stop-lever plate by means of its mounting screw.

422. Break Lever Adjusting Plate
(B, fig. 277)

a. Preparation. The typing unit is removed from the base.

b. Requirements. There should be some clearance, not more than 0.015 inch, between the rear upper corner of the beveled edge on the left end of the upper contact lever and the lower front edge of the stop lug on the send-receive stop-lever plate, when the break lever is slowly operated by hand until the two edges are just opposite each other.

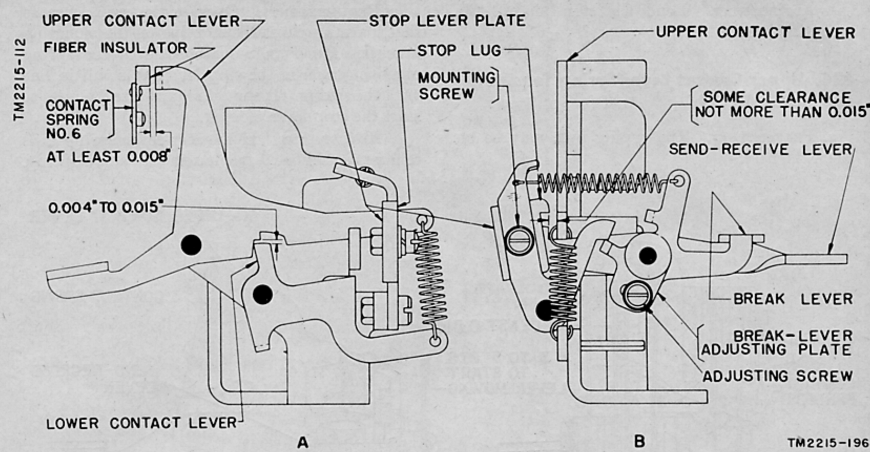


Figure 277. Stop-lever plate adjustment.

c. Adjustment. Position the break lever adjusting plate by means of its adjusting screw.

423. Stop Lug

(A, fig. 278)

a. Preparation. The typing unit is removed from the base.

b. Requirements. When the send-receive stop lever is in its unoperated position, the upper extension of the stop lever should rest against the stop lug on the mounting bracket, and there should be some clearance, not more than 0.030 inch, between the rear side of the upper contact lever and the front edge of the send-receive stop-lever plate.

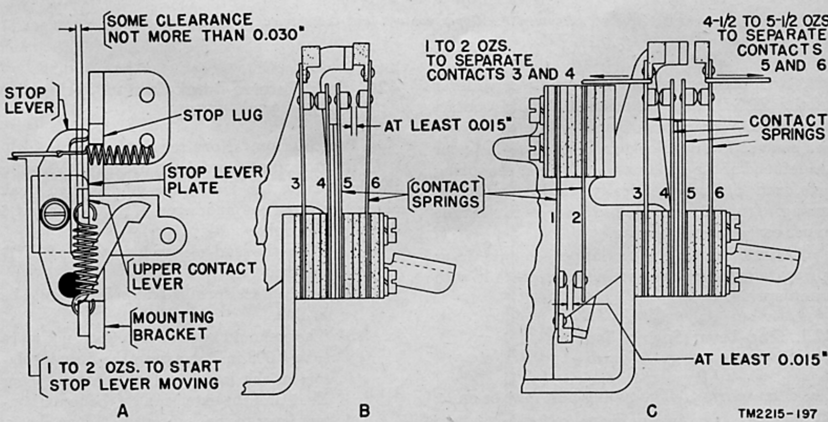


Figure 278. Stop lug adjustment.

c. ADJUSTMENT. Bend the stop lug on the mounting bracket.

424. Upper Contact Lever Spring Tension
(B, fig. 279)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Operate the stop lever so that it rests against the stop lug on the mounting bracket. Hook an 8-ounce scale in the spring mounting hole in the stop lever, and pull in line with the spring. It should require 1 to 2 ounces to start the stop lever moving.

c. ADJUSTMENT. If the stop-lever spring fails to meet requirements, replace it with a new spring.

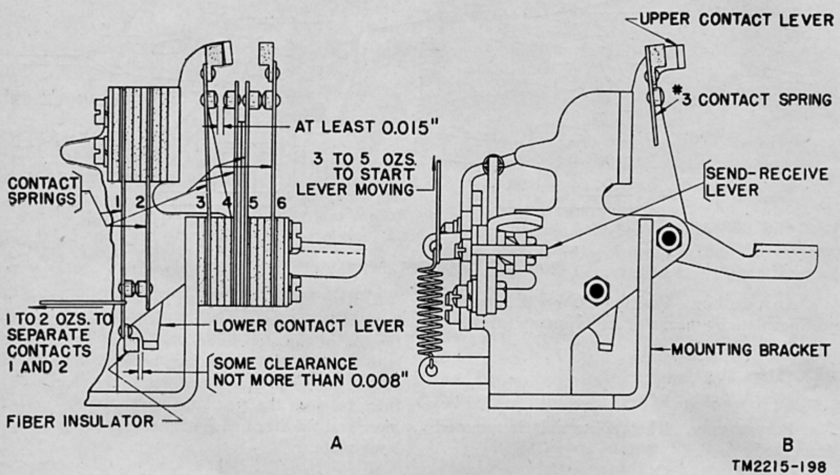


Figure 279. Upper contact lever adjustment.

b. REQUIREMENTS. Place the send-receive lever in the SEND (up) position and hold contact spring No. 3 away from the extension on the upper contact lever. Hook an 8-ounce scale under the left end of the upper contact lever at the spring hole, and pull up vertically, in line with the spring. It should require 3 to 5 ounces to start the upper contact lever moving.

c. ADJUSTMENT. If the upper contact lever spring fails to meet requirements, replace it with a new spring.

425. Stop-Lever Spring Tension
(A, fig. 278)

a. PREPARATION. The typing unit may be on or off the base.

426. Send-Receive-Break Contact Springs
(figs. 278 and 279)

a. PREPARATION. None required.

b. REQUIREMENTS AND ADJUSTMENTS. Viewing the base from the front, the send-receive-break contact springs are numbered 1, 2, 3, 4, 5, and 6 from left to right.

(1) Move the send-receive lever to the SEND position (up).

(2) All contact springs and points should be in line.

(3) There should be some clearance, not more than 0.008 inch, between the fiber insulator on the lower end of contact spring No. 1 and the extension on the lower contact lever to the right of it. When check-

ing this clearance, the lower contact lever should be held firmly against its top. Adjust by bending contact spring No. 2.

(4) Contact No. 1 should exert a pressure against contact No. 2. Hook an 8-ounce scale around contact spring No. 1, just below the contact point, and pull horizontally toward the left. It should require 1 to 2 ounces to just separate contact Nos. 1 and 2. Adjust by bending contact spring No. 1. Recheck ((3) above).

(5) All the clearance requirements, pertaining to contact springs Nos. 3 through 6, given in the following paragraphs will usually be met if these three preliminary requirements are met:

(*a*) The stiffeners for contact springs Nos. 4 and 5 should be straight.

(*b*) Contact springs Nos. 4 and 5 should rest against their respective stiffeners with perceptible tension. There should be no gaps between the ends of the stiffeners and the contact springs when the contacts are open. However, a gap not more than 0.004 inch will be permissible at any other point.

(*c*) With the send-receive lever in the REC position (down), the extension on the upper contact lever should be approximately midway between imaginary lines extending up from contact springs No. 4 and 5. If necessary, bend the extension on which the double contact springs are mounted to meet this requirement. It will be permissible to vary this requirement, if necessary, in cases where the clearance requirements given in (*d*) through (*i*) cannot be met.

(*d*) With send-receive lever in the SEND position (up), there should be a clearance of at least 0.015 inch between contacts No. 3 and 4. If necessary to adjust, see (5) above.

(*e*) Move the send-receive lever to the REC position (down) and make sure that contacts No. 3 and 4 close.

(*f*) There should be at least 0.015-inch clearance between contacts Nos. 1 and 2. Adjust by bending contact Spring No. 2. Recheck (3) above (C, fig. 278).

(*g*) Contact No. 3 should exert a pressure against contact No. 4. Hook an 8-ounce scale around contact spring No. 3 just above the contact point, and pull horizontally toward the left. It should require 1 to 2 ounces to just separate contacts Nos. 3 and 4. Adjust by bending contact spring No. 3. Recheck (*d*) above (C, fig. 278).

(*h*) With the left end of the upper contact lever held against the stop lug on the stop-lever plate, there should be at least 0.008-inch clearance between the fiber insulator on contact spring No. 6 and the extension on the upper contact lever. Make certain that contacts Nos. 5 and 6 are separated by at least 0.015 inch when the break lever is operated. If necessary to adjust, see (5) above (A, fig. 277, and B, fig. 278).

(*i*) Contact No. 6 should exert a pressure against contact No. 5. Hook an 8-ounce scale around contact spring No. 6 just above the contact point and pull horizontally toward the right. It should require 4½ to 5½ ounces to just separate contact Nos. 5 and 6. Adjust by bending contact spring No. 6. Recheck (*h*) above (C, fig. 278).

427. Control Relay Adjustments
(fig. 280)

a. For break operation the control relay (A, fig. 280) should be adjusted to meet the following requirements:

(1) With the relay plunger held operated, there should be 0.005-inch to 0.015-inch clearance between the contact surfaces of the outer and middle contact springs. Adjust by bending the outer contact spring.

(2) With the plunger held operated, there should be 0.025-inch to 0.030-inch clearance between the contact surfaces of the inner and middle contact springs. Adjust by bending the inner contact spring.

(3) When an 8-ounce scale is hooked over the middle contact spring at the side of the contact and pulled horizontally at right angles to the contact spring, it should require 5 to 6 ounces to cause the middle

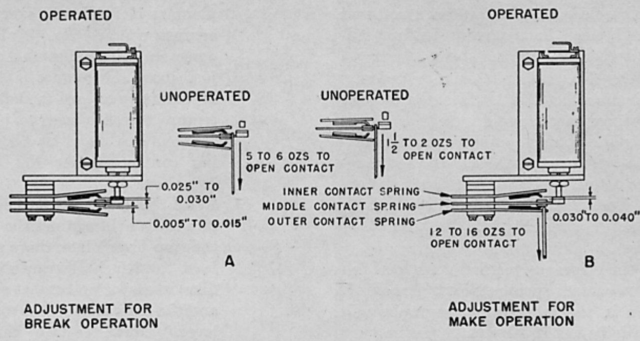


Figure 280. Control relay.

contact spring to break contact with the inner contact spring. Adjust by bending the middle contact spring.

(4) Recheck (2) above.

b. For make operation the control relay (B, fig. 280) should be adjusted to meet the following requirements:

(1) Hold the relay plunger operated, hook a 32-ounce scale over the end of the outer contact spring, and pull horizontally at right angles to the contact spring. It should require 12 to 16 ounces to cause the outer contact spring to break contact with the middle contact spring. Adjust by bending the outer contact spring.

(2) With the relay plunger held operated, there should be 0.030-inch to 0.040-inch clearance between the contact surfaces of the inner and middle contact springs. Adjust by bending the inner contact spring.

(3) Hook an 8-ounce scale over the middle contact spring at the side of the contact, and pull horizontally at right angles to the contact spring. It should require 1½ to 2 ounces to cause the middle contact spring to break contact with the inner contact spring. Adjust by bending the middle contact spring.

(4) Recheck (2) above. The operating current for the control relay should be between 50 and 60 ma when adjusted for either make or break operation.

428. Rec–29 Rectifier Adjustments

(fig. 49)

Move the power switch to the OFF position and open the hinged door in the rectifier cover. The secondary voltage of the transformer is 300 volts. *Do not make any adjustments while the rectifier is in operation.*

a. To adjust for a-c input voltage, connect the flexible lead on the left-hand side of the panel to the terminal with the marking which most nearly corresponds to the voltage of the available a-c supply.

b. To adjust for frequency, connect the two flexible leads on the right-hand side of the control panel to the two terminals having markings which most nearly correspond to the frequency of the available a-c supply.

c. To adjust d-c output voltage, connect a 600-ohm resistor in series with a suitable milliammeter across the d-c output of the rectifier, and connect the flexible leads located near the top of the control panel to the terminals (marked L, M, H, and 1, 2, 3, 4, 5) which cause the milliammeter to register a current flow which is nearest to but not less than 0.2 ampere.

d. Check this adjustment when the rectifier is installed and periodically thereafter. Voltage drop due to initial aging of the rectifying assembly decreases with service. After the first few months of use the rectifier should operate for long periods without the necessity for readjustment. If it becomes necessary to use the maximum regu-

lation tap to obtain the proper output current, withdraw the rectifier from service and repair it. Refer to figure 51 for actual wiring diagram and figure 285 for schematic wiring diagram.

429. Rec–10 Rectifier Adjustments
(fig. 48)

a. Three coarse and five fine secondary transformer taps are provided which terminate in spring jacks marked L, M, H, and 1, 2, 3, 4, 5 for readily adjusting the d-c output voltage for any particular line requirement and to correct for aging of the rectifier element.

b. Rectifier adjustments are set at the factory on taps M and either 1, 2, or 3 to deliver 0.2 ampere at 120 volts d-c.

c. The method normally used in checking the d-c output of this rectifier is to disconnect all apparatus from the d-c side and connect a 600-ohm resistor in series with a suitable milliammeter across the output. For correct adjustment of the output, the flexible leads shall be connected to those taps which will cause the milliammeter to register a current flow which is nearest to but not less than 0.2 ampere. Check this adjustment when the rectifier is installed and periodically thereafter. The amount of aging will be somewhat greater during the first few months of use.

d. If it is necessary to use the maximum regulating tap to obtain the proper output current, withdraw the rectifier from service and repair it. Refer to figure 50 for actual wiring diagram and figure 286 for a schematic wiring diagram.

430. Schematic and Wiring Diagrams

Figures 281 through 287 are schematic and wiring diagrams for Teletypewriters TT–5/FG and TT–6/FG or components of these sets. Reference to these diagrams will aid in tracing the various over-all circuits and in locating the different circuit elements. Figure 281 shows schematically the wiring of the table and connections to the rectifier and teletypwriter base.

431. Explanatory Notes on Figures 283 and 284

a. FIGURE 283. All wires are # 18 insulated wire except the motor leads. Thin lines indicate wires not in the cable.

b. FIGURE. 284.

(1) The wire color code used in figure 284 is the same as that used in figure 283 (see note 12, fig. 283).

(2) For single-line operation when Rec–10 or Rec–29 is used as the source of line battery, connections are as follows:

(*a*) *At station furnishing battery.* Line is connected to terminal Nos. 7 and 10; terminal Nos. 8 and 11 and Nos. 9 and 12 are strapped. When line plugs are inserted in the line jacks, battery goes to the teletypewriter base. The slider on the 2,500-ohm resistor should be adjusted to produce 60-ma line current.

(*b*) *At station not furnishing battery.* Line is connected to terminals Nos. 7 and 10; and terminals Nos. 8 and 9 are strapped.

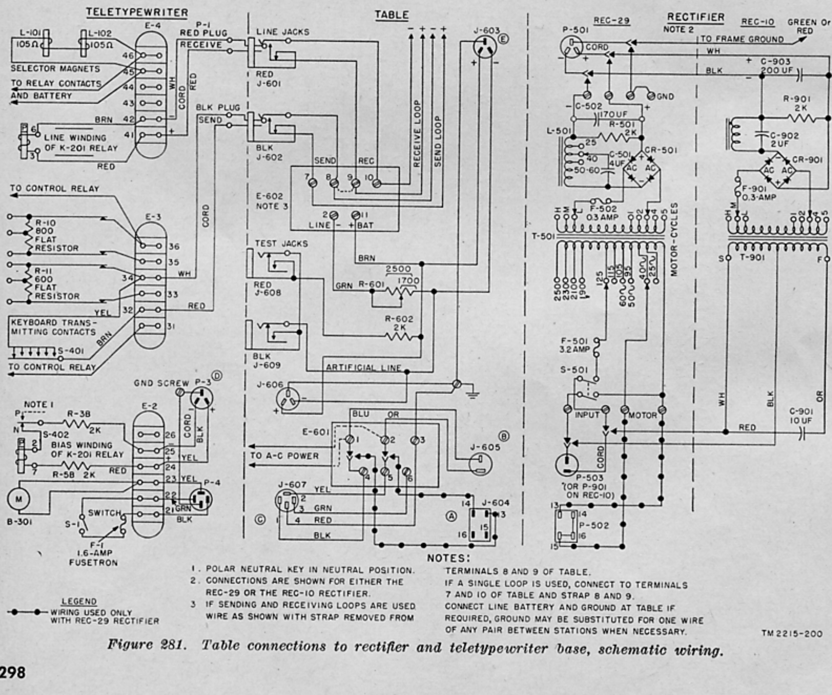


Figure 281. Table connections to rectifier and teletypewriter base, schematic wiring.

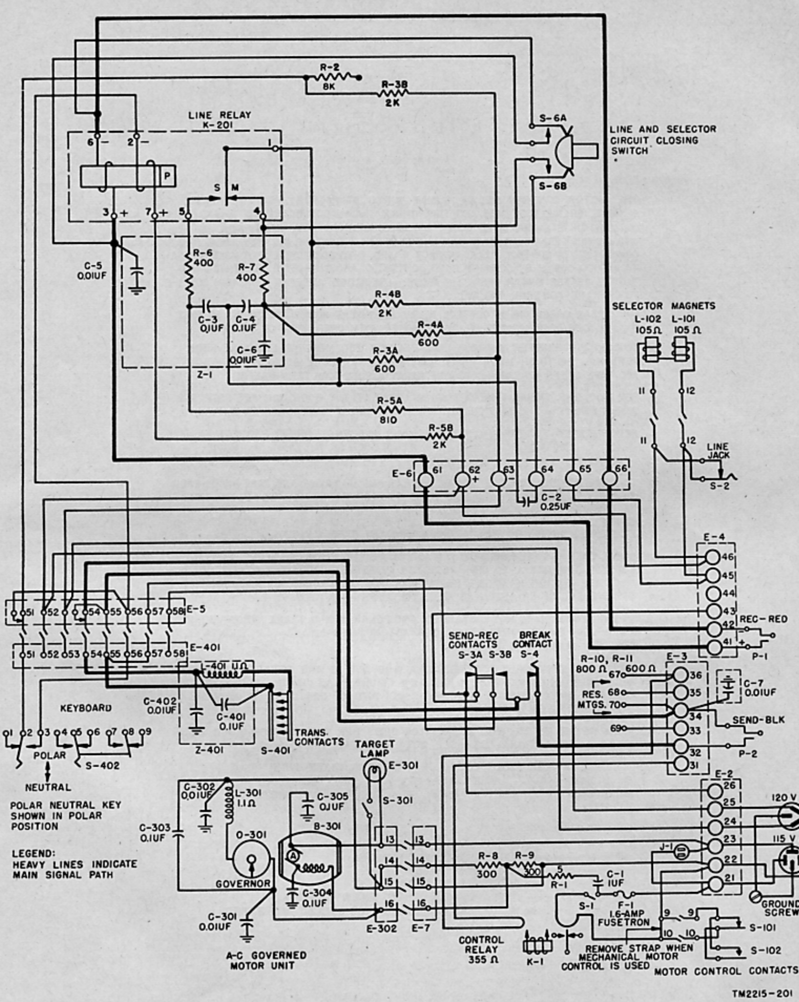


Figure 282. Typing unit, keyboard, base, and relay, schematic wiring.

NOTES:

1. THE MOTOR CONTROL RELAY IS NOT WIRED AT FACTORY. TO USE RELAY, REMOVE, SPLICE TOGETHER AND TAPE WIRES SHOWN CONNECTED TO A AND B ON SWITCH S-1. CUT WIRE LOOP AT SWITCH AND CONTROL RELAY COIL K-1 AND CONNECT TO RESPECTIVE UNITS. FOR BREAK OPERATION CUT WIRE LOOP F-G, CONNECT G TO CONTROL RELAY CONTACT E AND F TO CONTACT D. FOR MAKE OPERATION CUT LOOP F-G, CONNECT G TO CONTACT C AND CONNECT F TO CENTER CONTACT D AS FOR BREAK OPERATION ABOVE. USE 0.065 AMPERES THROUGH COIL L-1 TO OPERATE CONTROL RELAY.
2. FOR BREAK OPERATION OF CONTROL RELAY K-1 INVERT POWER SWITCH S-1 SO THAT ON AND OFF DESIGNATIONS ON COVER AGREE WITH OPERATION OF SWITCH.
3. TO OPERATE PRINTER WITHOUT LINE RELAY K-201, MOVE YELLOW WIRE FROM TERMINAL 62 TO 61; MOVE WHITE WIRE FROM TERMINAL 65 TO 66; REMOVE AND TAPE GREEN WIRE GOING TO LINE RELAY K-201 FROM TERMINAL 61.
4. FOR 0.02-AMP. SIGNAL LINE OPERATION, CONNECT THE 8000-OHM RESISTOR R-2 IN SERIES WITH THE BIAS CIRCUIT BY MOVING ONE OF THE LEADS ON A TO B.
5. RECOMMENDED FUSETRON OR FUSTAT (AND ALTERNATE FUSE) PROTECTION.

MOTOR	FUSETRON OR FUSTAT	FUSE
110 VOLTS A.C. 60-CYCLE GOVERNED	1.60-AMPS	3-AMPS SEE FUSE F-1

6. TO DISABLE SEND RECEIVE BREAK MECHANISM: (A) SPLICE AND TAPE WIRES FROM SWITCH S-3A MARKED X; (B) TAPE WIRE TO S-3B MARKED Y; (C) SPLICE AND TAPE WIRES TO S-4 MARKED Z.
7. ELEMENTS SHOWN DOTTED ARE UNDERNEATH BASE CASTING.
8. WHEN THE A-C SERIES MOTOR MUST BE DRIVEN FROM 25-CYCLE POWER SUPPLY, CONNECT A 25 OHM RESISTOR IN SERIES WITH THE POWER LEADS IF COMPENSATION HAS NOT BEEN MADE FOR 25 CYCLES BY ADJUSTMENT OF THE RECTIFIER (SUCH AS REC 29) TAPS.
9. WHEN KEYBOARD IS NOT INSTALLED AND POLAR SIGNALS ARE RECEIVED, REMOVE JUMPER BETWEEN BACK CONTACT NUMBER 51 AND SLIP CONNECTION CONTACT NUMBER 56 ON BASE.
10. CONTACTS SHOWN BETWEEN TERMINALS 9 AND 10 ARE PRESENT ON TYPING UNIT ONLY WHEN MOTOR CONTROL ON FIGURE H IS USED. WHEN MOTOR CONTROL (MECHANICAL THROUGH S-101 AND S-102) IS USED, REMOVE STRAP BETWEEN 9 AND 10.
11. K-201 RELAY (RY 30; W.E. 255-A)-136 OHMS PER WINDING (FOR 0.060 OR 0.020 AMPERE SIGNALING — SEE NOTE 4 ABOVE)
12. WIRE COLOR CODE (SOLID COLOR OR TRACER IN WHITE WIRE)

BK BLACK	O ORANGE	BL BLUE
BR BROWN	Y YELLOW	W WHITE
R RED	G GREEN	

LEGEND:

———— WIRING
━━━━ MAIN SIGNAL PATH WIRING
— — — ENCLOSES UNITS
– – – – ENCLOSES FILTERS
-------- OUTLINES ELEMENTS UNDER CASTING
——✱ INDICATES WIRES TAPED OR SPLICED AND TAPED

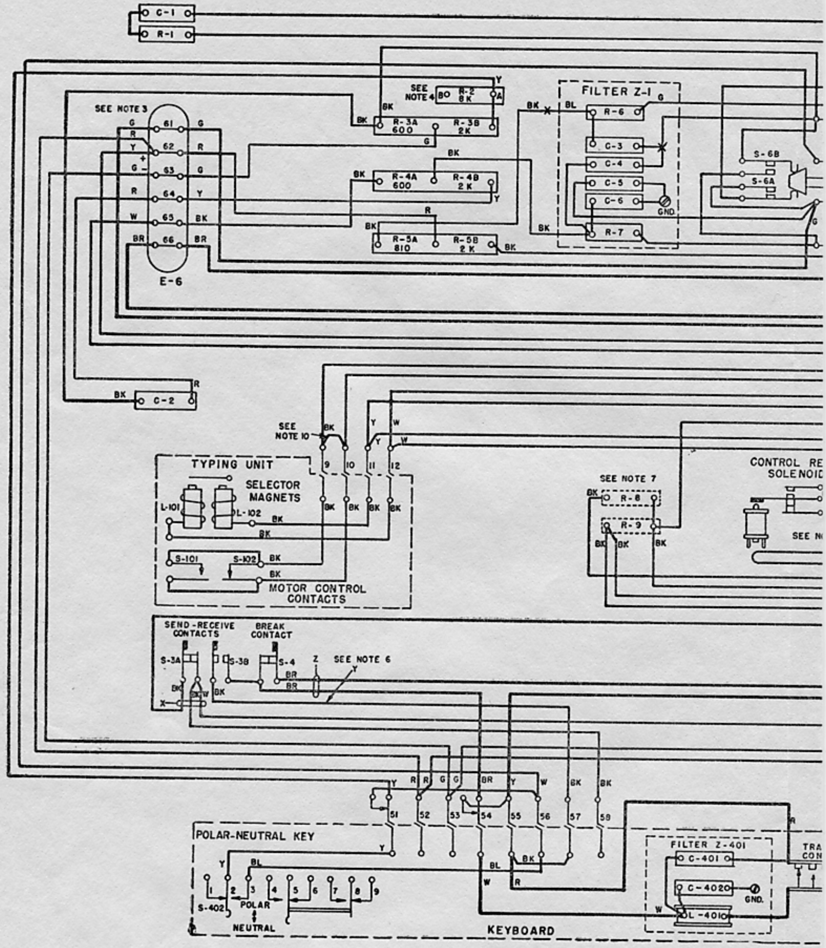
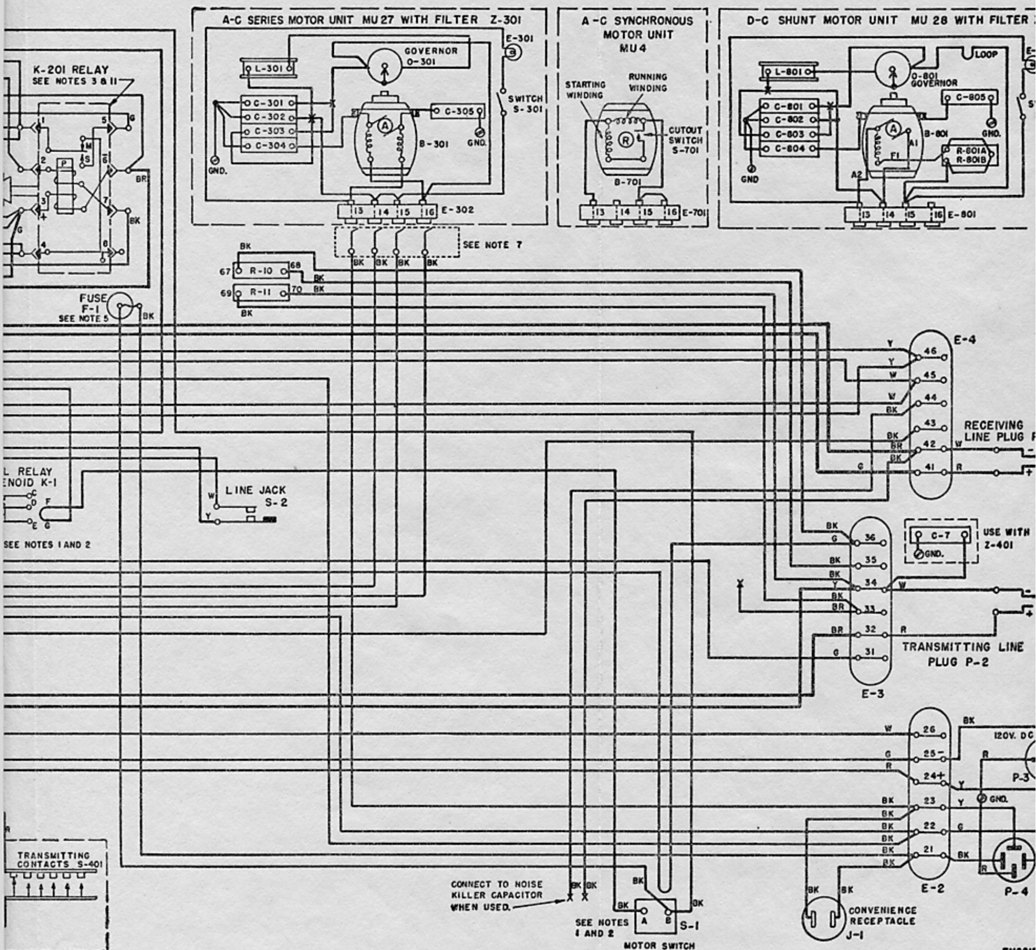


Figure 283. Actu



Actual wiring of typing unit, keyboard, base, and relay.

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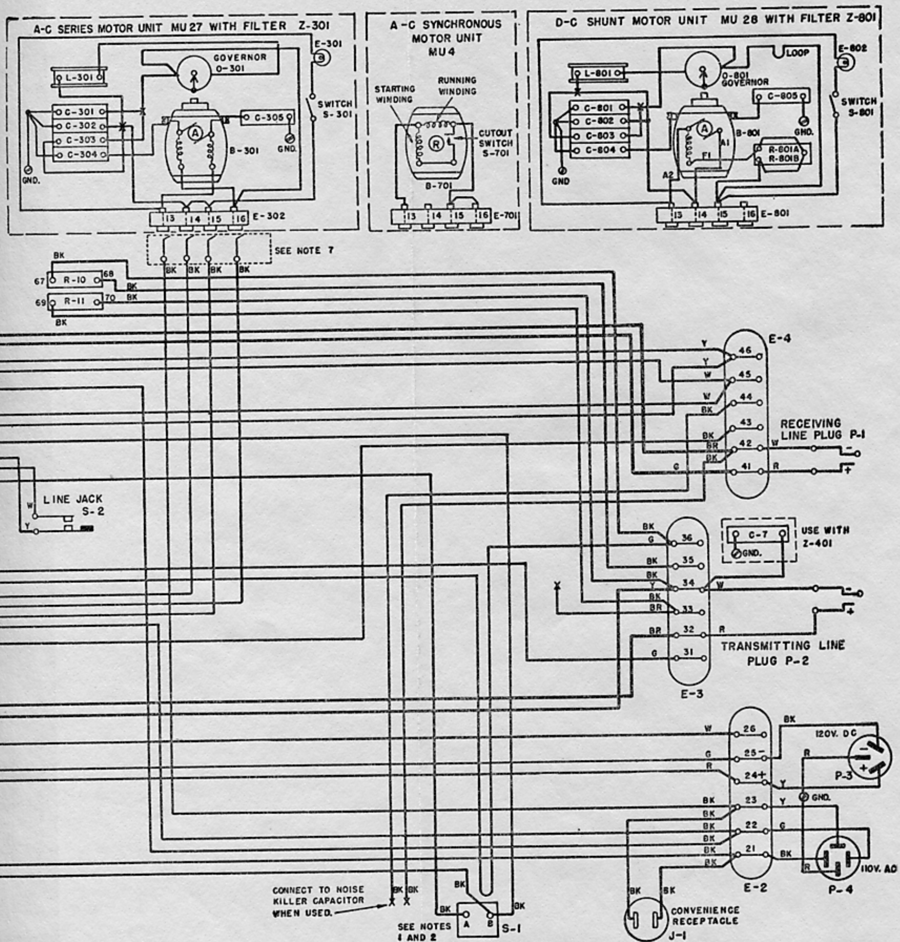
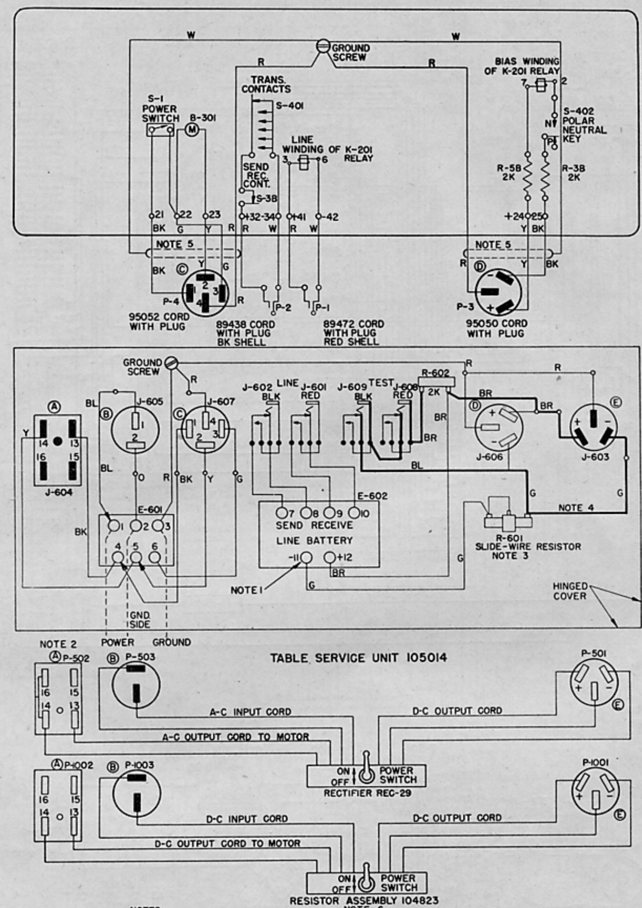


TM2215-202

ng unit, keyboard, base, and relay.



NOTES:

1. LOOP BATTERY MAY BE SUPPLIED FROM TERMINALS 11 AND 12 IF REQUIRED.
2. CONNECTOR PLUGS AND TABLE SERVICE ASSEMBLY RECEPTACLES TO WHICH THEY CONNECT ARE DESIGNATED BY ENCIRCLED LETTERS.
3. ZERO TO 2500 OHM SLIDE-WIRE RESISTOR ADJUSTED TO 1700 OHMS AT FACTORY.
4. HEAVY LINE INDICATES LOCAL TEST CIRCUIT.
5. (⊂====⊃) INDICATES SHIELDED CABLE
6. AN A-C SERIES MOTOR MAY BE OPERATED ON DC WHEN THIS RESISTOR UNIT IS USED IN PLACE OF A RECTIFIER.

TM2215-203

Figure 284. Electrical service assembly schematic with simplified teletypewriter and rectifier diagrams.

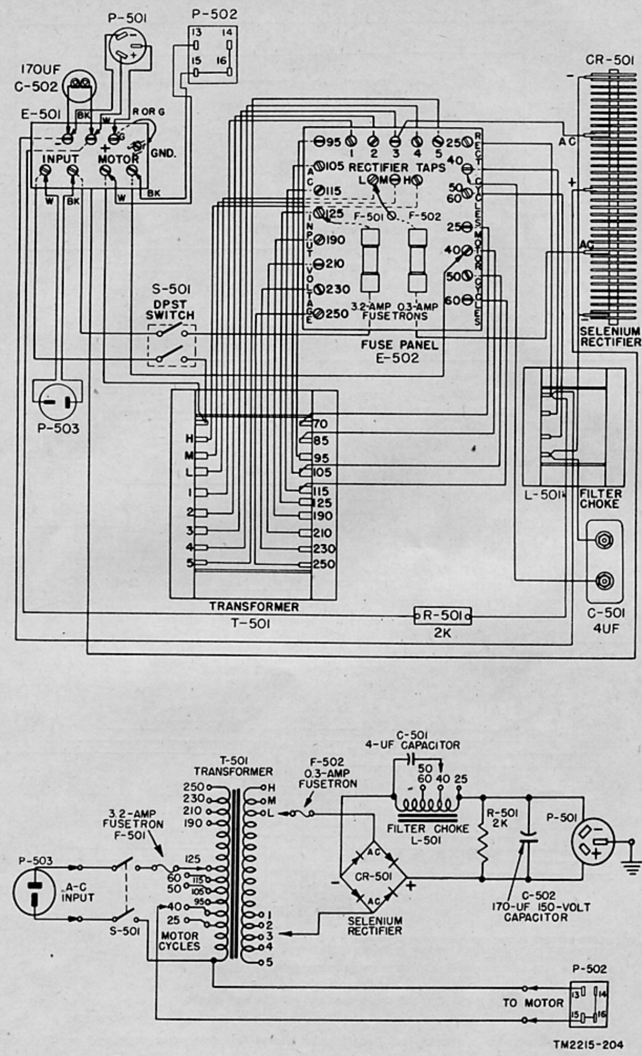


Figure 285. Rec–29 rectifier, actual and schematic wiring.

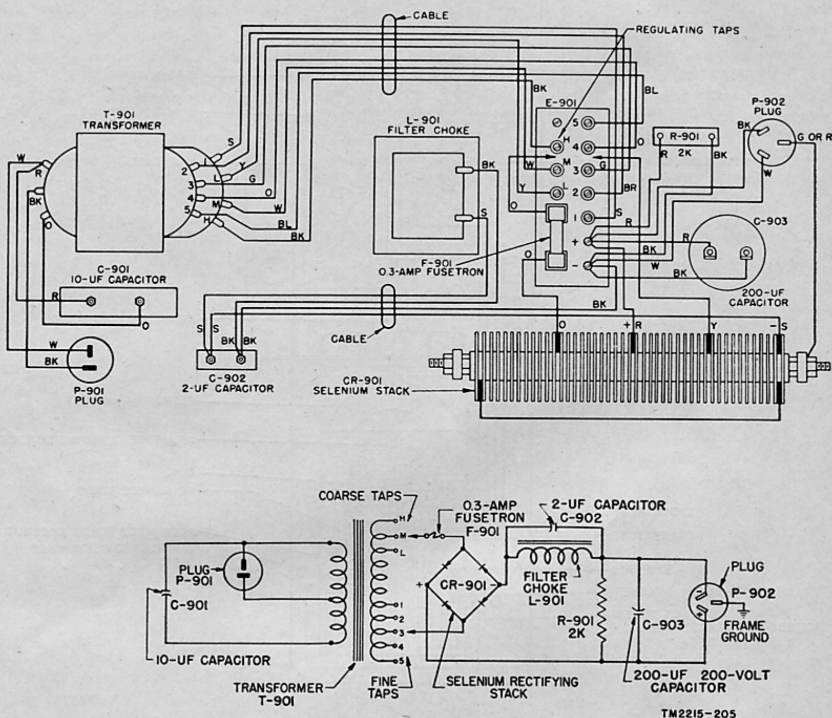


Figure 286. Rec–10 rectifier, actual and schematic wiring.

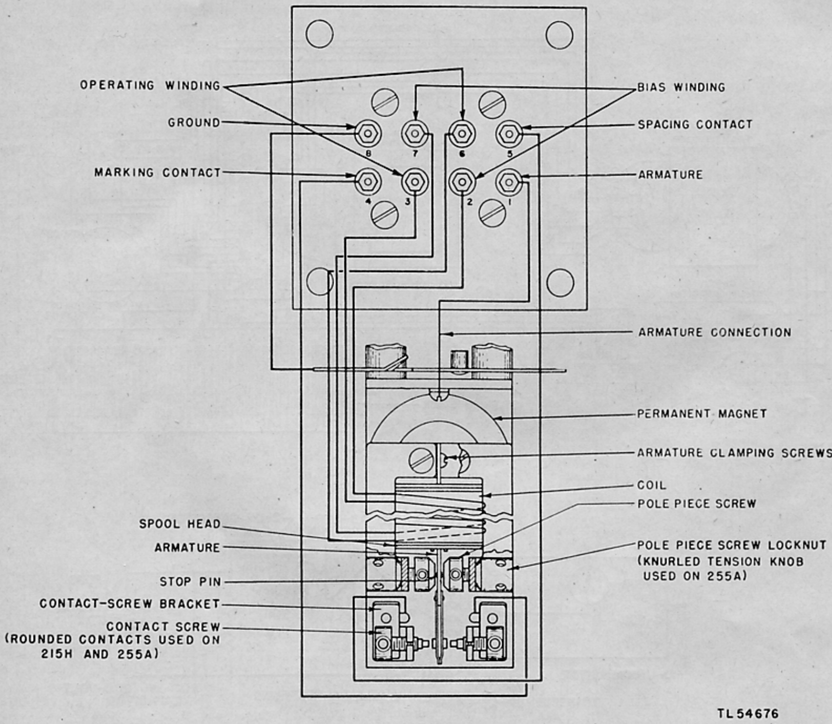


Figure 287. Ry–30 relay, wiring diagram.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

432. Disassembly and Repacking

a. Disassembly. To disassemble the parts, proceed as follows:

(1) Remove the copyholder from the typing unit cover.

(2) Remove the crank from the typing unit and place it in the cloth drawstring bag provided for it.

(3) Remove the typing unit cover from the base unit.

(4) Remove the cover front plate from the lower front part of the typing unit cover. Replace and tighten the four nuts on their bolts to avoid loss.

(5) Disassemble the paper roll spindle and the ribbon from the typing unit and place them in the drawstring bag with the platen crank.

(6) Remove the keyboard from the base.

(7) Remove the typing unit from the base. Replace and tighten the three thumbscrews in their holes in the base.

(8) Disassemble the motor unit from the base. Replace and tighten the motor hold-down screws in their holes in the base.

(9) Disassemble the polar relay from its mounting bracket on the base.

(10) Remove the base from the table.

(11) Remove the rectifier from the table.

(12) Disassemble the electrical service assembly from the table. Replace screws in their holes in the electrical service assembly.

(13) The table and the other units are now ready for repacking.

b. Repacking. Many illustrations arranged in the text in this section show how components of the teletypewriters are packed when personnel, to whom packing duties are assigned, have available such packing materials as are used when the equipment is originally packed. If such material is not available, the illustrations suggest how necessary packing materials may be improvised. Containers for the various units bear PK numbers which are stamped on them at the factory. Parts of the packing containers are given detail numbers which are also stamped on them at the factory. Some of these details are flat pieces of scored cardboard. Folds along these scored lines aid in shaping the flat pieces into containers needed for packing specific units.

(1) Brace, cushion, and place the component parts in cartons as for domestic shipment. Seal the seams and flaps of these cartons with 3-inch gummed tape or special staples. Later these cartons are placed in wooden boxes.

(2) Cartons which are to be sealed in flexible barriers (those least subject to damage from moisture) should have their corners blunted before they are wrapped and sealed.

(3) Seal the waterproof paper barriers with waterproof cement and seal the moisture-vaporproofed foil-lined barriers with adhesive or other suitable material which is equal in strength and waterproofing qualities to the barrier material.

(4) Float the metal container, which holds the typing unit, in a nailed wooden box containing 3 inches of excelsior (fig. 27). The wooden boxes, except the box for the typing unit which is numbered No. I (1/4), are lined with flexible waterproof barrier material.

(5) Fill all large vacant spaces with a void detail of correct size and shape.

Note. Instructions for packing the various components of the teletypewriters are given in paragraphs 433 through 443.

433. Typing Unit Cover
(figs. 288 and 289)

This paragraph provides instructions for packing a model 15 teletypewriter cover for domestic shipment.

a. Packing material (figs. 288 and 289) for a standard model 15 teletypewriter cover consists of the following:

Quantity	Material	Part No.
1	Corrugated Carton	PK–10717
1	Label FRAGILE MATERIAL, HANDLE WITH CARE.	PK–21250
1	Corrugated detail set consisting of scored sheets as follows: 1 detail A ($17\frac{7}{16}''$ x $54\frac{9}{16}''$). 1 detail B ($17''$ x $38\frac{1}{2}''$). 2 detail C ($13''$ x $16\frac{3}{8}''$). 1 detail D ($19\frac{3}{4}''$ x $20\frac{1}{8}''$) with notched corners.	PL–22141

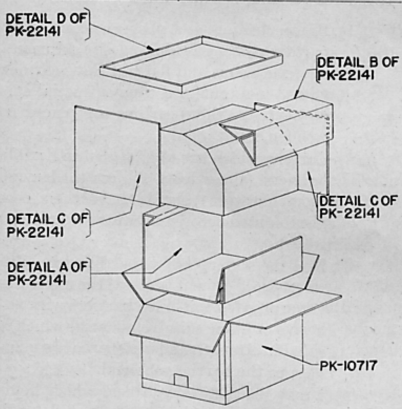


Figure 288. Materials for packing cover.

b. Additional material needed but not furnished consists of 18 feet of gummed paper tape 3 inches wide and 12 square feet of tissue paper.

c. To pack the typing unit cover, proceed as follows:

(1) Form the bottom of the corrugated carton PK–10717 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

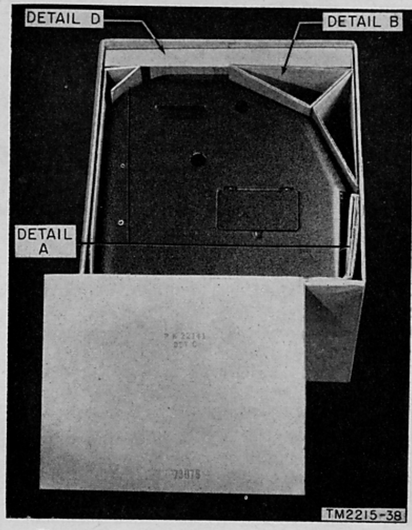


Figure 289. Cover in place in fiberboard carton.

(2) Remove the copyholder from the cover by removing its four mounting screws. Place the four screws in a small envelope. Wrap the wooden filler with a piece of tissue paper. Place the wooden filler and envelope on the front side of the copyholder and wrap all three parts into one bundle with tissue paper.

(3) Place the wrapped copyholder assembly inside at the left end of the cover, and tie securely by means of a string passed through the large hole in the cover and the left bottom edge.

(4) Form corrugated detail A of PK–22141 as scored. Place the cover on the detail so that the lower folded section is at the

front of the cover. Place one detail C at each end of the cover. While keeping the details in position against the cover by holding them at opposite corners, place them, together with the cover, in the carton (figs. 288 and 289).

(5) Form corrugated detail B (fig. 288) as scored. Place the detail in the carton at the upper front part of the cover over the glass as shown in figure 289.

(6) Form corrugated detail D as scored (fig. 288). Place it on top of the cover inside the carton with the formed edges upward forming a tray (fig. 289).

(7) Close and seal the top flaps of the carton as indicated in $c(1)$ above.

434. Cover Front Plate and Paper Spindle

a. Cover Front Plate (fig. 24).

(1) Remove the front cover; then replace and tighten the nuts on their bolt studs.

(2) Wrap the front plate in tissue paper and place it in the PK–8527 corrugated carton.

(3) Inclose and seal the PK–8527 carton in a moisture-vaporproof envelope.

(4) Inclose the moisture-vaporproofed carton in the PK–8542 corrugated carton.

(5) Pack it in the nailed wooden box No. 4 (marked 4/4) with consolidated pack and other parts.

b. Paper Spindle (fig. 31). Place the spindle in the drawstring bag with the platen crank and ribbon. Tie this bag, by means of its string, to the right side frame between the spindle drag spring and the retaining plate (fig. 293).

435. Keyboard

(figs. 290 and 291)

a. The packing material for a standard model 15 keyboard consists of the following:

Quantity	Material	Part No.
1	Corrugated carton	PK–9187
1	Label FRAGILE MATERIAL, HANDLE WITH CARE.	PK–21250
1	Corrugated detail set consisting of scored sheets as follows: 2 detail A (5⅜″ x 22½″). 2 detail B (6¾″ x 25½″). 1 detail C (14⅞″ x 26¼″). 1 detail D (10¼″ x 20 15/16″).	

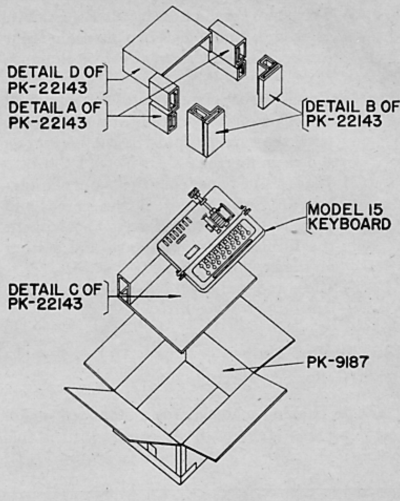


Figure 290. Packing keyboard.

b. Additional material needed but not furnished consists of 13 feet of gummed paper tape 3 inches wide and 4 square feet of tissue paper.

c. When packing the keyboard, proceed as follows:

(1) Form the bottom of the corrugated carton PK–9187 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(2) Tie the two thumbscrews to prevent them from rattling.

(3) Form corrugated detail C as scored, and place it in the carton as indicated in figures 290 and 291.

(4) Place the model 15 keyboard centrally in the carton on top of detail C with the gear directly over the formed section of the detail as shown in figure 291.

(5) Form two corrugated details B (fig. 290) as scored, and place one at each front corner of the keyboard as shown in figure 291.

(6) Form two corrugated details A as scored, and place one at each side of the keyboard with the smaller folds at the bottom as shown in figure 291.

(7) Place tissue paper over the top of the keyboard. Form detail D as scored and place it over the top of the keyboard with the formed ends downward and resting on the keyboard (fig. 291).

(8) Close and seal the top flaps of the carton.

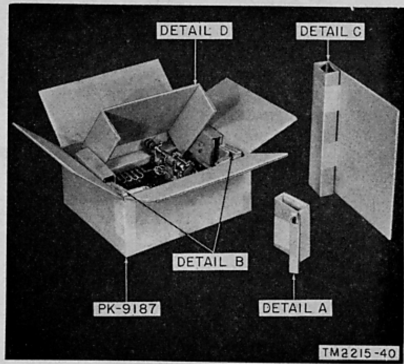


Figure 291. Keyboard in fiberboard carton.

436. Typing Unit

(figs. 294 through 301)

a. The packing material for a standard model 15 typing unit (friction feed) consists of the following:

Quantity	Material	Part No.
1	Corrugated carton (fig. 300)	PK-10718
1	Corrugated carton (fig. 300)	PK-11289
1	Unpacking instruction card	PK-21217
1	Label FRAGILE MATERIAL, HANDLE WITH CARE.	PK-21250
10	No. 8 wood screw	PK-21277
1	Bracket (fig. 295)	PK-21296
1	Bracket	PK-21297
1	Cloth bag (figs. 293 and 296)	PK-21300
1	Sheet, wax paper (fig. 296)	PK-21305
4	No. 8 wood screw	PK-21345
2	Scored corrugated detail sheet (20″ x 46½″) (fig. 300).	PK-22214
4	Scored corrugated detail sheet (17⅜″ x 35″) (fig. 300).	PK-22215
1	Set of packing details (fig. 294) consisting of: 2 detail No. 4 plywood panels (fig. 299). 1 detail No. 5 L-shaped wooden block 1⅛″ thick (fig. 296). 1 detail No. 6 small wooden block 1⅛″ thick with clearance cut (fig. 296). 1 detail No. 7 wooden base assembly (fig. 296).	PK-22238
1	Lower blocking assembly	PK-22239
1	Upper blocking assembly	PK-22240
1	Top frame assembly (fig. 299)	PK-22241
4	Wedge lock (fig. 299)	82074

b. Additional material needed but not furnished includes 10 fivepenny nails, 8 fourpenny nails, 4 square feet of tissue paper, 33 feet of gummed paper tape 3 inches wide, 15 feet of cloth tape at least 2 inches wide, and two 1-inch spacer blocks approximately 2 inches wide and 6 inches long.

c. When packing the typing unit, proceed as follows:

(1) Place the typing unit on the detail No. 7 base assembly in such a position that the two printer studs are centered in the 1¼-inch clearance holes of members E and F of detail No. 7 (figs. 294 and 296). There should be no space between the rear of the side frames and members G and H of detail No. 7 (fig. 297).

(2) Place detail No. 5 firmly against the right side frame and insert two PK-21345 fillister-head wood screws in the holes provided (fig. 296).

(3) Place detail No. 6 firmly against the left side frame, and insert two PK-21345 fillister-head wood screws in the holes provided (fig. 296).

(4) Loosen the front screws on the right and left lower carriage track supports (fig. 295).

(5) Free the type-bar carriage by depressing the carriage-return lock bar and move it to its central position. While holding the carriage in this position, place the

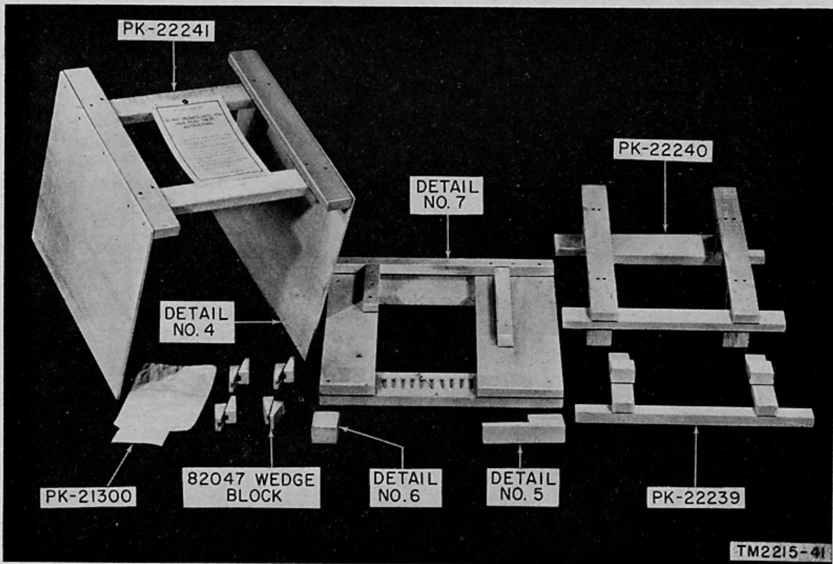


Figure 292. Typing unit crate.

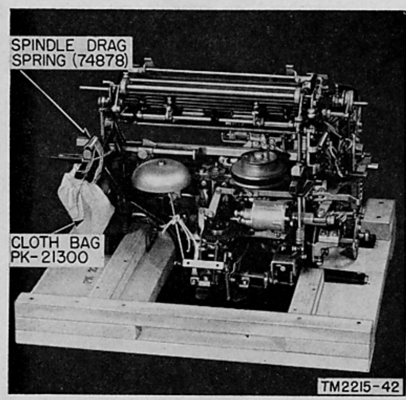


Figure 293. Typing unit in place on wooden base assembly, rear view.

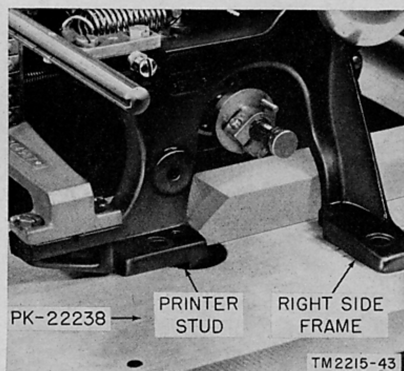


Figure 294. Typing unit in place on wooden base assembly, right side view.

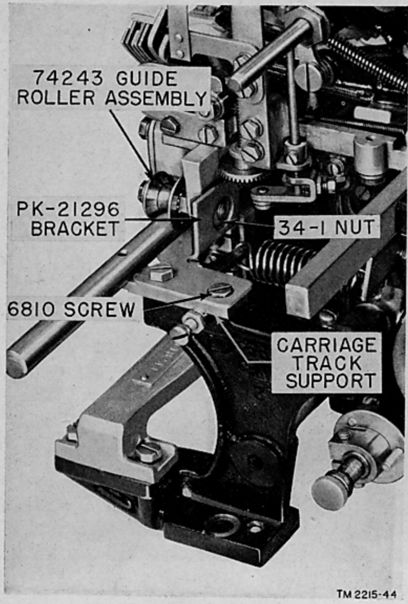


Figure 295. Right carriage bracket installed on typing unit.

right bracket under the front washer of the front screw and over the rear screw on the right carriage track support. Engage the $^{33}/_{64}$-inch hole of the bracket with the 34–1 rear nut of the guide roller assembly on the carriage, and fasten the bracket friction tight in this position with the screw that was previously loosened. Do not tighten the screw.

(6) Mount the left bracket in a similar manner and tighten the track support front mounting screws.

(7) Press the carriage-return lock bar again to make certain that any stress on the spacing mechanism is relieved (fig. 297).

(8) Remove the paper roll spindle, the ribbon, and the platen crank. Place them in the cloth bag provided and tie the bag, by means of its string, to the right side frame between the spindle drag spring and the retaining plate.

(9) Fasten the other end of the bag to detail No. 5 with a tack or nail (fig. 296). Fasten the cloth bag sufficiently tight to prevent swinging.

(10) Tie the signal bell hammer to the rear crossbar with a suitable string.

(11) Place the sheet of wax paper between the type-bar backstop and the type bars as shown in figure 296.

(12) Fold tissue paper into a pad and place it on top of the type bars. Bind the paper pad in position so that the type bars are held down by means of a string tied to the type-bar backstop as shown in figure 296.

(13) Place the lower block assembly in position on the typing unit so that the $^{7}/_{16}$-inch clearance holes in the cubic blocks are over the lower carriage-track support screws as shown in figure 297.

(14) Place the upper blocking assembly in position so that the members N engage the $^{7}/_{8}$-inch notched section of member J, and so that member P rests firmly on the rear projections of the right and left side frames as shown in figure 298.

(15) Place one 1-inch spacer block on each member L an equal distance from each end (fig. 298).

Note. These spacer blocks provide uniform spacing for the engagement of wedge locks which are used later.

(16) Assemble the two plywood panels (detail No. 4) to members B with five five-penny nails each so that the panels are flush with the tops of members B, and so that the drilled holes in the panels are located at the bottom (opposite end from members B) (fig. 299).

(17) Place the assembly over the typing unit with the plywood panels to the front and rear of the typing unit.

(18) Fasten the plywood panels (detail No. 4) to members C, E, and F of detail No. 7 by means of 10 No. 8 wood screws inserted through the holes drilled in the panels. The panels should be flush with the bottom of members C (fig. 299).

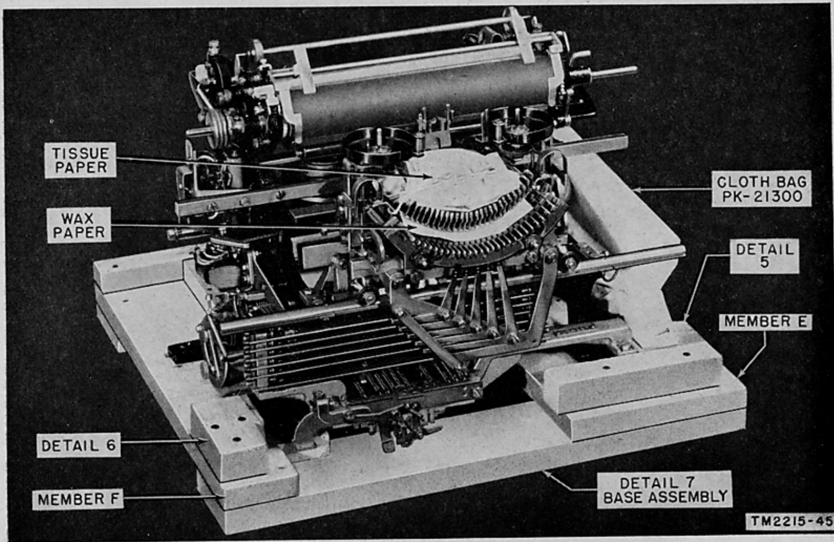


Figure 296. Typing unit in place on wooden base assembly, front view.

(19) Assemble the four wedge locks, with the ends of their springs hooked to the nail in each half of the wedge lock, and insert them between the parallel members A and member L directly above the vertical members (fig. 299).

(20) Remove the spacer blocks (fig. 299) and tap members A lightly above the wedge locks to increase the tension applied by the wedge locks and to remove any looseness in the assembly.

(21) Fasten each *top wedge only* of the wedge locks to member A with two 1-inch nails.

(22) Check all details for correct position and for any movement between the typing unit and the assembled crate.

(23) Staple or tack the unpacking instruction card to the members A of the top frame as shown in figure 292.

(24) Form the bottom of the corrugated carton PK–10718 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(25) Place the crated typing unit in the PK–10718 carton and seal the flaps.

(26) Stencil THIS SIDE UP and OPEN HERE on top of the carton with waterproof ink.

(27) Make up corrugated carton PK–11289, then close and seal the bottom.

(28) Form one PK–22214 corrugated detail sheet as scored and place it in the bottom of PK–11289 with the pleats downward adjacent to the bottom flaps of the carton.

(29) Place the sealed carton PK–10718 inside carton PK–11289 on top of the formed corrugated detail (fig. 300).

(30) Form and insert one corrugated detail sheet of PK–22215 at each corner of the sealed carton as shown in figure 300.

(31) Form another PK–22214 corrugated detail sheet and place it on top of the sealed carton.

(32) Close and seal the top flaps of the PK–11289 carton.

(33) Place two bands of cloth tape girthwise around the PK–11289 approximately 4 inches from the edges. The ends of the tape should overlap each other approximately 3 inches.

(34) Stencil THIS SIDE UP and OPEN HERE on the top of the PK–11389 carton.

(35) Apply the PK–21250 label FRAGILE MATERIAL, HANDLE WITH CARE to the top of the carton.

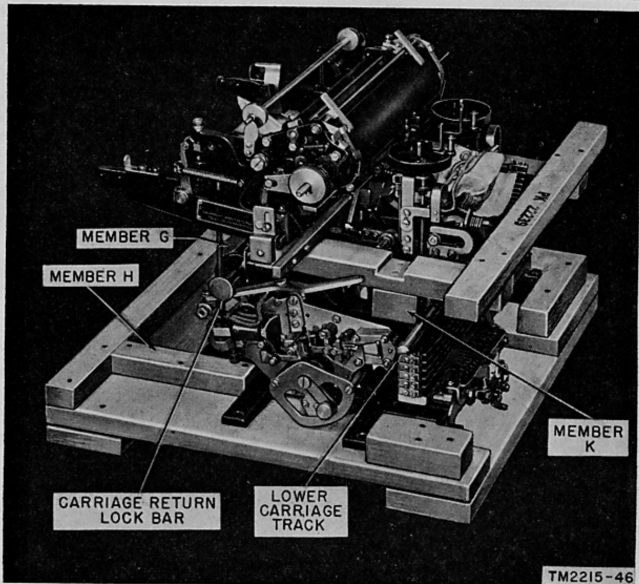


Figure 297. Typing unit in place on wooden base assembly, left side view.

437. Motor Unit
(figs. 302 and 303)

a. The packing material for a motor unit (synchronous or governed) consists of the following:

Quantity	Material	Part No.
3	Screw	RM–71677
3	Nut	RM–71292
3	Lockwasher	2669
6	Washer	RM–72295
1	Corrugated carton (with liner)	PK–9603
1	Label FRAGILE MATERIAL, HANDLE WITH CARE.	PK–21250
1	Set-up (lamp) box	PK–21280
1	Wooden base	PK–22113

b. Additional material needed but not furnished includes 10 feet of gummed paper tape 3 inches wide and 4 square feet of tissue paper.

c. When packing the motor unit, proceed as follows:

(1) Place the motor unit on the wooden base so that the three motor-plate mounting holes line up with the three drilled holes in the wooden base (fig. 302).

(2) Fasten the motor unit to the wooden base by means of the three RM–71677 screws,

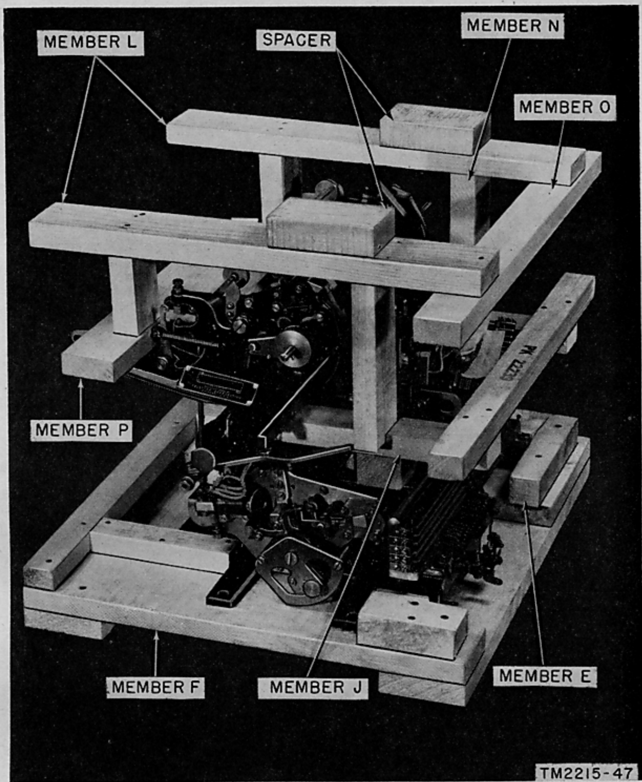


Figure 298. Typing unit crate.

the 74032 washers, the RM–72295 washers, the 2669 lockwashers, and the RM–71292 nuts as shown in figure 302. If the motor unit has a target lamp, remove the lamp; wrap it in tissue paper, place it in set-up box PK–21280 (fig. 303), and securely tie the box to the lamp bracket with a string which should be passed through the wire loops of the box.

(3) Form the bottom of the corrugated carton PK–9603 (fig. 303) as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(4) Place the motor unit and the attached wooden base in the carton so that the wooden base rests on the bottom of the carton.

(5) Place the corrugated liner around the in-

side of the carton so that its bottom end rests on top of the wooden base. Make certain that the top edge of the liner does not extend above the top of the carton.

(6) Close and seal the top flaps of the carton.

(7) Apply a label FRAGILE MATERIAL, HANDLE WITH CARE to the top of the carton.

438. Relay

This paragraph provides instruction for domestic packing of the RY–30 relay and protection of this unit against excessive contact corrosion and formation of black dust due to the presence of hydrocarbon vapors.

a. The packing materials for the RY–30 relay consist of the following:

Quantity	Material	Part No.
1	Corrugated fiberboard carton (fig. 304).	PK–8741
1	Corrugated fiberboard detail	PK–22156
1	Moisture-vaporproofed barrier	PK–23188
2	2-oz bag of silica gel	PK–21226
2	Gas adsorbing unit.	
4 ft.	3″ gummed paper tape	PK–21205

b. Packing of the RY–30 relay in a heat-sealed, moisture-vaporproofed barrier with dehydrating agent is described in (1) through (7) below. Pack the relay in accordance with the methods and sequence of operations as follows:

(1) Place the RY–30 relay packed in the supplier's carton in the moisture-vaporproofed barrier PK–23188.

(2) Place the corrugated fiberboard detail PK–22156 over the relay carton with two 2-ounce bags of silica gel.

(3) Insert the barrier bag containing the gas adsorbing detail unit against the silica gel inside the gel tray and heat-seal the barrier PK–23188.

(4) Form the corrugated fiberboard carton PK–8741. Seal the long seams of bottom flaps with 3-inch gummed tape and use additional strips for sealing the flaps along the ends of the carton.

(5) Place the sealed moisture-vaporproofed barrier PK–23188 in the outer carton PK–8741.

(6) Close the top flaps of the carton and seal it with 3-inch gummed tape.

(7) Mark the carton as required.

439. Base Unit

(figs. 305 and 306)

a. The packing material for a standard model 15 base consists of the following:

Quantity	Material	Part No.
1	Corrugated carton	PK–9920
1	Label FRAGILE MATERIAL, HANDLE WITH CARE.	PK–21250
1	Corrugated detail set consisting of scored sheets as follows: 1 detail A (15⅝″ x 47⅝″). 3 detail B (10¼″ x 28¾″). 1 detail C (10¼″ x 27¹⁄₁₆″). 2 detail D (6¾″ x 18″).	PK–22139

b. Additional material needed but not furnished

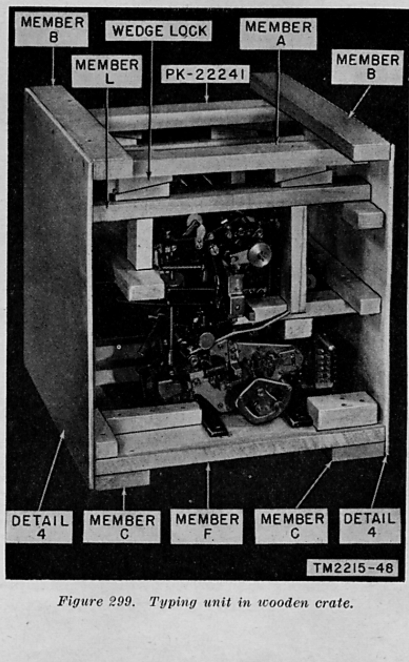


Figure 299. Typing unit in wooden crate.

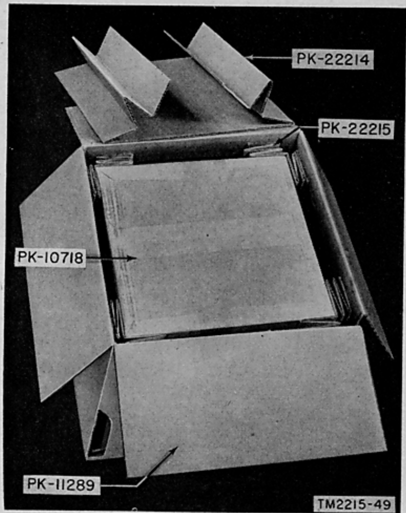


Figure 300. Cartons and pads protecting typing unit.

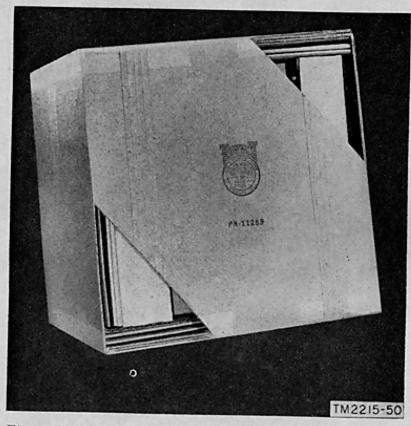


Figure 301. Outer carton containing typing unit, cutaway view.

includes 18 feet of gummed paper tape 3 inches wide and 10 square feet of tissue paper.

c. When packing the base unit, proceed as follows:

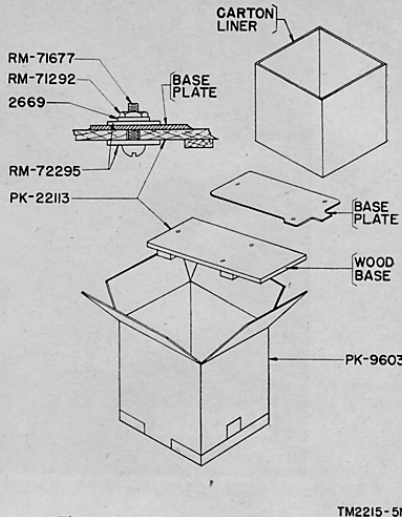


Figure 302. Motor unit packing details.

(1) Remove the relay from the mounting bracket.

(2) Fold the base cords, wrap them in tissue paper, and place them in the large cavity of the base; tie them securely with a string inserted through a large hole at the right side (fig. 306).

(3) Form the bottom of the corrugated carton PK–9920 as scored (fig. 305). Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(4) Fold detail A of PK–22139 as scored (fig. 305). Place the detail centrally in the bottom of the carton.

(5) Place the model 15 base in the carton between the folded sections of detail A, with the rear part of the casting toward the smaller folded section.

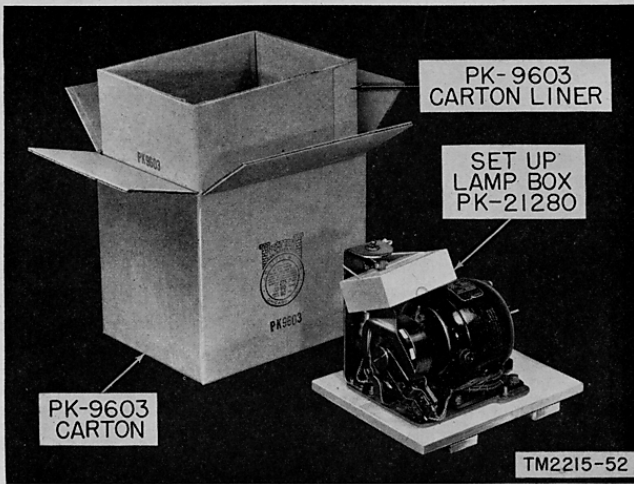


Figure 303. Motor unit ready to place in fiberboard carton.

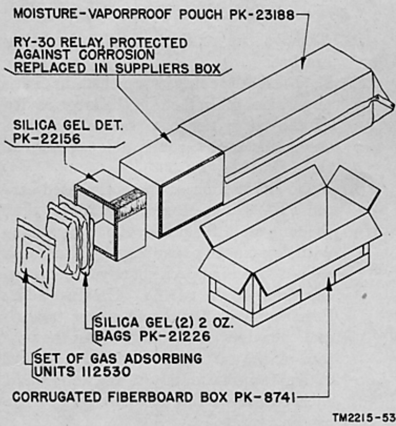


Figure 304. RY-30 relay, method of packing.

(6) Fold detail C of PK-22139 as scored and as shown in figure 305. Place it between the side of the base and the inside of the carton at the corner of the base where the toggle switch is mounted (fig. 306).

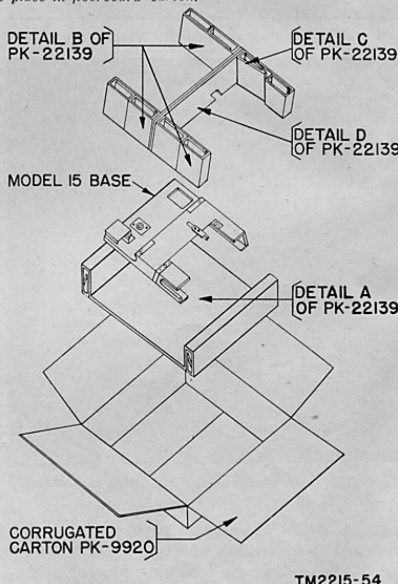


Figure 305. Model 15 base, packing details.

Make sure that the top of the detail is flush with the top of the carton.

(7) Fold the three details B of PK–22139 as scored (fig. 305). Place them between the side of the base and the inside of the carton at the other three corners of the base. Make sure that they are flush with the top of the carton (fig. 306).

(8) Place the two details D together so that the slits in their edges meet. Form a notch at the slits to provide clearance for the contact pile-up near the middle of the base as shown in figure 306.

(9) Place the two details D edgewise across the top of the base so that one end fits between the two details B and the other end between detail B and detail C (fig. 306). Make sure that the top edges of details D are flush with the top edge of the carton.

(10) Close the top flaps of the carton and seal them with gummed paper tape in the same manner as indicated in (3) above.

440. Rectifier Power Unit

When packing the rectifier power unit, proceed as follows:

a. Coil the cords together on top of the rectifier and wrap paper around the plug and two receptacles to pad and hold them in place.

b. Place the rectifier in a fiberboard carton.

441. Electrical Service Assembly

When packing the electrical service assembly, proceed as follows:

a. Wrap the assembly in tissue paper and place it in a suitable corrugated carton. Leave the mounting screws tightened in their holes in the assembly as protection against loss.

b. Inclose and seal the cartoned assembly with a tray containing 1 pound of silica gel in a moisture-vaporproofed barrier.

c. Place the moisture-vaporproofed package in a PK–8985 corrugated carton and float with consolidated package and other parts in the nailed wooden box No. 4 (marked 4/4).

442. Table

a. Materials used in packing the table are as follows:

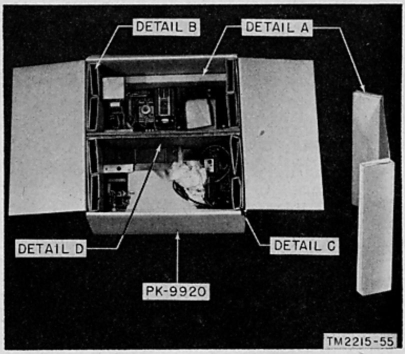


Figure 306. Base packed in protective carton.

Quantity	Material	Part No.
1	Corrugated fiberboard carton	PK–11291
1	Corrugated fiberboard tray	PK–11291
1	Wooden top frame detail A	PK–22194
1	Wooden bottom frame detail B	PK–22194
1 (sheet)	Tissue paper	PK–21298
As required	Suitable twine.	
18 ft	3 in. gummed paper tape	PK–21205
1	Gummed label	PK–21250
1	Gummed label	PK–21328

b. When packing the table, proceed as follows:

(1) Form the corrugated fiberboard cartons PK–11291. Seal the long seams of the bottom flaps with 3-inch gummed tape and use two additional strips for sealing the flaps along the ends of the carton. The gummed tape shall at all times extend approximately 3 inches beyond the ends of the flaps and approximately the same at all sides and ends of the carton.

(2) Place the wooden detail B in the bottom of the carton.

(3) Wrap the rubber feet in tissue paper and tie them securely to the shelf of the table with suitable twine.

(4) Place the table in carton PK–11291 and locate the legs within the wooden frame detail B.

(5) Form the corrugated fiberboard tray

PK–11291 by folding the four flanges downward and place it over the top of table.

(6) Place the wooden frame detail A over the fiberboard tray on top of table.

(7) Close the top flaps of the carton and seal with 3-inch gummed tape.

(8) Paste a label to the top rear right of the carton indicating OPEN HERE, THIS SIDE UP.

443. Arranging Consolidated Package

a. Wrap the following parts and spare parts in tissue paper and place them in their individual pressed fiberboard cartons. Coat the gear set with grease or other preservative before placing it in the carton.

Part No.	Quantity	Description	Carton
103284	5	Fusetron	PK–6796
103286	5	Fusetron	PK–6796
74557	2	Lamp	PK–6796
101063	5	Fusetron	PK–6628
102701	5	Fusetron	PK–6628
103628	1	Speed indicator	PK–6774
7835	2	Ribbon	PK–6628
80374	1	Set of gears	PK–7532

b. Place the individual cartons in a larger fiberboard carton.

c. Pack this carton in a nailed wooden box No. 4 (marked 4/4) with the motor unit, cover, cover front plate, copyholder, electrical service assembly, and the two technical manuals which must be inclosed in a moisture-vaporproofed envelope.

Section II. DEMOLITION TO PREVENT ENEMY USE

444. Methods of Demolition

a. SMASH. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

b. CUT. Use axes, handaxes, machetes.

c. BURN. Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

d. EXPLODE. Use firearms, grenades, TNT.

e. DISPOSE. Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

f. OTHER. Use anything immediately available for destruction of this equipment.

445. Destruction of Components

When ordered by the commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash the typing unit, rectifier power unit, relay, table, resistors, capacitors, switches, nameplates, and other identifying marks.

b. Cut all wiring, cords and cables, and relay.

c. Burn instructions, diagrams, circuit labels, etc.

d. Bury or scatter any or all of the above pieces after smashing.

e. Destroy everything.

APPENDIX I

REFERENCES

Note.—For availability of items listed, check SR 310–20–3 for field manuals, SR 310–20–4 for technical manuals and technical bulletins, and Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Technical Manuals for Equipment Associated With Teletypewriters TT–5/FG and TT–6/FG.

TM 11–352	Printer TG–7–A and Teletypewriters TG–7–B and TB–37–B.
TM–11–356	Radio Teletype Terminal Equipment, AN/FGC–1 or AN/FGC–1X.
TM 11–358	Telegraph Central Office Set TC–3, and Switchboard BD–100.
TM 11–359	Line Units BE–77, BE–77–A, and BE–77–B, and BE–77–C.
TM 11–2036	Test Set I–181.
TM 11–2056	Test Unit I–236 and I–236–A.
TM 11–2201	Reperforator Teletypewriter Sets TC–16 and TC–17.
TM 11–2208	Test Set TS–2/TG. Teletype Manual No. 43.
TM 11–2209	Teletypewriter Set 131B2.
TM 11–2217	Distortion Test Set TS–383/GG and TS–383A/GG.
TM 11–2222	Transmitter Distributors Teletype Model 14.
TM 11–2223	Typing and Nontyping Reperforators, Teletype Model 14.
TM 11–2513	Test Set I–193–A.
TM 11–2626	Test Unit I–176.
TM 11–5500	Multimeter TS–297/U.

2. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.

3. Packaging and Packing Information

a. MILITARY (JAN) SPECIFICATIONS.

JAN–D–169	Desiccants, (activated).
JAN–P–100	General specification.
JAN–P–106A	Boxes; wood, nailed.
JAN–P–116	Preservation, methods of.
JAN–P–125	Barrier-materials, waterproof, flexible.
JAN–P–131	Barrier-material; moisture-vaporproof, flexible.

b. U. S. ARMY SPECIFICATIONS.

100–2E	Marking shipments by contractors, standard specification for (and Signal Corps Supplement thereto).

c. SIGNAL CORPS INSTRUCTIONS.

720–7 Standard Pack.

726–15 Marking of Interior Containers (for Signal Corps Equipment).

4. Decontamination

TM 3–220 Decontamination.

5. Demolition

FM 5–25 Explosives and Demolitions.

6. Other Publications

SB 11–47	Preparation and Submission of Requisitions for Signal Corps Supplies.
SR 310–20–3	Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training

SR-310-20-3—Con.	Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310-20-4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 700-45-5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD-247).
SR 745-45-5	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD-66).
TB SIG 25	Preventive Maintenance of Power Cords.
TM 1-455	Electrical Fundamentals.
TM 11-462	Signal Corps Tactical Communication Reference Data.
TM 11-680	Teletypewriter Circuits and Equipment (Fundamentals).

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite a specific T/O & E, T/A, SIG 7–8–10, SIG 10, list of allowances of expendable material, or other authorized supply basis. The Department of the Army Supply Catalogs applicable to the equipment covered in this manual are SIG 10–853, Typing Units TT–5/FG and TT–6/FG; SIG 10–854, Keyboard Units, Model 15; SIG 10–855, Printer Base, Models 15 and 19; SIG 10–866, Rectifier Unit Rec–29; and SIG 10–TT–5/FG and TT–6/FG. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG I.

1. General

Figures 307 through 339 illustrate and identify parts used in Teletypewriters TT–5/FG and TT–6/FG. Numbers for parts shown in these illustrations are the manufacturer's part numbers. Signal Corps stock numbers for the parts illustrated appear in paragraph 2 of this appendix. In nearly all instances the Signal Corps stock numbers are the manufacturer's part numbers plus the prefix 4T.

2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
1	TELETYPEWRITER TT–5/FG: fixed station; std com keyboard; English characters; 72 characters per line; sending and receiving; friction paper feed; 110 v ac, 50/60 cyc series governed motor; 5-unit code; for wire com; remote stop on H key.	Sends and receives telegraph messages.	4T2.18A–1
	TELETYPEWRITER TT–6/FG: fixed station; weather com keyboard; English characters; 76 characters per line; sending and receiving; friction paper feed; 110 v ac, 50/60 cycle series governed motor; 5 unit code; for wire com; remote stop on H key.	Sends and receives telegraph messages.	4T2.16A–1
	PARTS FOR BASE, TELETYPE PART # BB44		
	BEARING, ball: single row radial; felt seal one side		4T80358 (same as 4T29464)
311	CABLE ASSEMBLY, power: 3 cond; RC; 11/32″ OD; 35″ lg; w/3 cont male connector one end; ring lugs and 4 leads other end.	Connects signal current to teletypewriter.	4T95050
311	CABLE ASSEMBLY, power: 4 cond; RC; 3/8″ OD; 35″; lg; w/polarized plug one end, 5 ring lugs other end.	Connects motor current to teletypewriter.	4T95052
309	CAPACITOR, fixed: paper; 250,000 $\mu\mu f$ +28% −0.%; 300 vdcw; 3 7/16″ lg x 1 1/2″ wd x 15/32″ thk (for synchronous motor only).	Part of line relay spark protection	4T81841
310	CAPACITOR, fixed: paper; 1μf ±10% vdcw; 4 9/16″ lg x 2″ wd x 3/4″ thk.	Spark suppressor in motor circuit	4T78011
311	CONNECTOR, male contact: 3 polarized cont	Part of cable assembly 95050	4T95063
311	CONNECTOR, male contact: 4 cont	Part of cable assembly 95052	4T95064
311	CORD, switchboard: brown cotton braid outer covering; 36″ lg.	Connects teletypewriter to send line.	4T89438

2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR BASE, TELETYPE PART # BB44—Continued		
311	CORD, switchboard: brown cotton line braid outer covering; 36″ lg.	Connects teletypewriter to receive line.	4T89472
313, 314	CUP, oil	Lubrication fitting	4T89896
307	FUSE, plug: 1.6 amp, 125 v; one time	Protects motor circuit	3Z2601.31 (same as 4T103286)
307	FUSE, plug: 3.2 amp, 125 v; one time	Protects motor circuit	3Z2603.11 (same as 4T103284)
310	RESISTOR, fixed: wire wound; 300 ohms ±10%; 40 w; 3 7/16″ x 3/4″ dia.	Part of suppressor in motor circuit	4T78205
308	RESISTOR, fixed: wire wound; 2810 ohms ±10%; 15 w continuous rating; tapped at 810 ohms; body .277″ ID, 9/16″ OD x 2″ lg.	Current limiter in shunt and bias circuits.	4T74821
308, 334	RESISTOR, fixed: wire wound; 2,600 ohms ±10%; 15 w; tapped at 2,000 ohms.	Limits current in magnet and bias circuit.	4T74614
307	SCREW, thumb: knurled head; 1/4″–20; 3/4″ lg under head w/5/8″ lg thd.	Secures printer unit to base	4T74720
333	SPRING: extension; .033″ dia music wire; 1 3/16″ lg x .259″ dia overall.	Aids in control of motor speed	4T6323
307, 311	SPRING: flat; jack type; .038″ nickel silver; slip connection cont; 1 3/16″ lg x 1 5/16″ h x 1/4″ wd overall.	Connects electrical circuits to printing unit motor and base.	4T7094
	SWITCH, lever: cont arrangement 1A and 2B; locking in one position.	Part of send, receive, break mechanism.	4T82917
307	SWITCH, toggle: SPST; bakelite body; 1 5/8″ lg x 5/8″ wd x 1 11/16″ h overall.	Motor ON-OFF switch	4T74620
	PARTS FOR MOTOR UNIT PU–109/GG, TELETYPE PART # MU27		
333	ARM ASSEMBLY: cont; nickel silver or steel; u/w outer disk; 3 3/8″ lg x 7/16″ wd x 19/32″ h overall.	Completes circuit to motor governor.	4T78399
333	ARM ASSEMBLY: cont; nickel silver or steel; u/w inner disk; 3 3/8″ lg x 7/16″ wd x 19/32″ h overall.	Completes circuit to motor governor.	4T78400
332	BEARING, ball: single row, self alining; bore .5118″; 1.1811″ OD x .2756″ wd.	Used to mount armature in the motor and allow it to rotate freely.	4T5061
332	BRUSH, electrical cont; carbon; 2 3/16″ lg x 3/8″ OD overall.	Completes electrical connection from motor commutator to filter unit.	4T8094
333	BRUSH, electrical contact: for governor; carbon copper pl.	Part of 4T78399 and 4T78400	4T78403
332, 334	CAP, contact brush: black bakelite; 21/32″ dia x 1/2″ lg overall.	Holds contact brush 4T8094 in place.	4T70873
334	CAPACITOR, fixed: paper; 10,000 $\mu\mu$f +22% −0%; 1200 vdct; 1 1/2″ lg x 9/16″ wd x 5/16″ thk overall.	Part of electrical noise suppressor	4T95937
334	CAPACITOR, fixed: paper; 100,000 $\mu\mu$f ±12%; 1200 vdct; oval, 2 1/8″ lg x 9/16″ wd x 5/16″ thk overall.	Part of electrical noise suppressor	4T95938
	COIL, RF: choke; single winding, layer wound; unshielded; 1.1 ohm dc resistance.	Part of electrical noise suppressor to reduce noise and arcing at opening and closing of governor contacts.	3C1988

2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR MOTOR UNIT PU–109/GG, TELETYPE PART # MU27—Continued		
333	CONTACT, governor: screw type w/tungsten point on head; steel; nickeled; #2–56 screw .080″ lg w/full thd; cont .250″ OD x .020″ thk.	Part of 4T6314 contact assembly for controlling speed of motor.	4T72835
333	CONTACT, governor: single tungsten cont ¼″ OD x 1/16″ thk; 1 29/32″ lg x ⅝″ h x ⅜″ thk overall.	Opens at critical speed to control motor speed.	4T6314
333	CONTACT, governor: screw type w/cont electro-welded to head; #6–32 screw .385″ lg w/.188″ lg thd; cont ¼″ dia x .020″ thk.	Aids in controlling motor speed	4T6320
333	CONTACT, governor: .0159″ thk nickel silver; governor outer cont spring; 1 15/64″ lg x .531″ wd x 43/64″ d overall.	Completes circuit in motor governor.	4T78496
333	CONTACT, governor: .159″ thk nickel silver; governor inner cont spring.	Completes circuit in motor governor.	4T78497
317, 331	GEAR: helical; fiber; 35 tooth, concave face	Driven gear of worm gear set	4T74151
331	GEAR ASSEMBLY: 368 opm, consists of 1 steel gear, 7 thd; and 1 bakelite gear, 35-tooth.	Motor and main shaft gearing	4T80374
333	GOVERNOR: motor; steel w/bakelite insulation; 3¼″ OD x 1 15/16″ thk overall; w/⅜″ hub.	Governs motor speed	4T80352
331	INSULATOR: rectangular, flat, 1.625″ lg x .812″ wd x .016″ thk.	Plate in motor terminal board	4T74991
331	LAMP, incandescent: 115v, 15 w; bulb T7 clear; 2⅝″ lg overall.	Illuminates target when motor speed is checked.	6Z6820–2 (supersedes 4T74557)
331	LAMPHOLDER: keyless; intermediate screw base; 2.125″ lg x 1.031″ OD overall.	Holder for target illuminating lamp.	4T74558
331	MOTOR UNIT PU–109/GG: series governed; 1/25 hp; 115 v, 60 cyc, single ph, .8 amp; includes governor assembly, filter unit and target lamp assembly, 2100 rpm.	Changes electrical power to mechanical power to operate teletypewriter.	4TMU27
332	MOTOR, AC: series wound; 1/25 hp; 95–130 v, 60 cyc, single ph, .8 amp; 2100 rpm.	Changes electrical power to mechanical power to operate teletypewriter.	4T77953
331	NUT, hexagon: steel, nickel pl; ⅜″–27; .140″ thk; .562″ wd across flats.	Mounts target lamp holder to target lamp bracket.	4T70892
333	NUT, hexagon: steel; zinc chromate; #6–32; 3/32″ thk; ¼″ across flats.	Secures contact 4T6320 above to mounting block.	4T6345 or 6L3606–32–4.3
307, 311, 313, 315, 317, 318, 325, 328, 329, 331, 333	SCREW, machine: slotted hex. head; steel, nickel finish; #6–40; ⅝″ lg under head.		4T6811
307, 310, 312, 313, 314, 315, 316, 318, 319, 321, 323, 324, 327, 328, 329, 331	SCREW, machine: slotted hex. head; #6–40; 5/16″ lg under head.		4T6746
308, 333	SCREW, machine: RH; brass; zinc chromate; #6–32; .250″ lg w/full lg thd.	Mounts governor cover and target to governor shell.	4T1064

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR MOTOR UNIT PU–109/GG, TELETYPE PART # MU27—Continued		
309, 316, 323, 324, 333	SCREW, machine: Fil H; #4–40; 5/16" lg under head threaded 9/32" lg.	Mounts governor contact brush springs to mounting plate.	4T1168
331	SWITCH, toggle: SPST; 2-position, bakelite body	Turns target illuminating lamp on or off.	3Z9692–8963 (same as 94009)
331	TARGET: governor flywheel; 20 divisions; 3.329" OD x 1/4" thk overall.	Aids in adjustment of motor speed	4T7105
307, 310 through 314; 316, 318, 320 through 325; 327, 328, 331, 333 through 335; 339.	WASHER, flat: steel, dull nickel finish; 9/64" ID, 5/16" OD x .032" thk.		4T7002
323, 331	WASHER, flat: steel, .170" ID, 1/4" OD x .037" thk		4T8330
307 through 329; 331 and 333 through 337.	WASHER, lock: split ring		4T2191 or 6L73006
307 through 311; 315 through 321; 323 through 325; 327, 331, 333	WASHER, lock: split ring		4T2669
308, 310, 319, 321, 333, 334, 335, 339	WASHER, flat: steel hardened	Spaces outer contact disk in mounting.	4T3438
331	WASHER, lock: 27/64" ID, 39/64" OD x .022" thk		6L72220–8C
	PARTS FOR COVER, TELETYPE PART #C105		
335	FELT: strip; black; soft finish	Protects cover glass at mounting edges.	4T74759
	GUIDE, line: steel, chrome; message and copyholder	Holds message being transmitted in place.	4T73641
335	WINDOW: 1/8" thk; laminated nonshattering glass	Prevents dust and dirt from getting into teletypewriter; permits operator to see message received or sent and provides tearing edge for received messages.	4T82425 (supersedes 4T104900)
335, 336	NUT, hexagon	Fastens part of cover	4T34–66

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR KEYBOARD, TELETYPE PARTS # BK22JK and # BK22KQ		
313	BUSHING, threaded: bronze, male; 23/64″ lg overall, bushing 5/16″ ID, 7/16″ OD x 1/4″ lg, thd 7/16″–32 x 3/16″ lg.	Mounts transmitting shaft	4T7373
314	BUSHING: bronze, male; 7/16″–32 thd x 17/32″ lg, 7/8″ lg overall.	Mounts transmitting shaft	4T71161
313	CONTACT, switch: stop type; .041″ nickel silver spring; 6 tungsten cont 1/8″ OD x 3/64″ h; 2 1/4″ lg x 1 9/16″ wd x 7/64″ thk overall.	Short contact springs of transmitting contact assembly.	4T9177
313	CONTACT, switch: multiple spring type; nickel silver; 2 1/4″ lg x 2″ wd x 7/32″ d overall.	Long contact springs of transmitting contact assembly.	4T9178
313	CONTACT ASSEMBLY, switch: spring type; keyboard transmitting cont.	Transmitting contact mounting assembly.	4T7381
313, 314	FELT: white back check felt; 13/32″ OD x 7/32″ lg	Oils cam sleeve shaft	4T90438
314	GEAR: spur; .625″ diam x .412″ lg overall; .376″ shaft hole, counterbored one end, other end chamfered, one .144″ mtg hole counterbored; 30 ratchet teeth on one side.	Drive clutch for keyboard shaft	4T7389
314	GEAR: spur; .750″ dia x .750″ lg overall	Driven clutch gear on keyboard shaft.	4T7391
314	GEAR: helical; bakelite; fine canvas base; 24 teeth	Drives transmitting shaft	4T74595
313	INSULATOR, plate: rectangular	Separates transmitting contacts	4T2504
313	INSULATOR, bushing: tubular	Separates transmitting contacts from mounting plate.	4T2529
313	LEVER: gooseneck shape, 1.578″ lg x 1.536″ wd x .065″ thk overall.	Operates keyboard transmitter contacts.	4T7318
313	LEVER: keyboard clutch; 1.500″ lg x .810″ wd overall.	Permits driven clutch member of transmitter clutch to engage driving clutch member.	4T7409
312	LEVER: key; .042″, steel; 8.278″ lg x .713″ h x .565″ wd overall.	Center key lever with keytop mounting disk.	4T9209
312	LEVER: key; .042″ hardened steel; 7.484″ lg x .902″ h x .548″ wd overall.	Upper key lever with keytop mounting disk.	4T9210
312	LEVER: key; steel; nickel pl; lower; 10″ lg x .721″ h x .548″ approx overall.	Lower key lever with keytop mounting disk.	4T74762
307, 310, 312 through 316; 318, 319, 321, 323, 324, 327 through 329; 331.	SCREW, machine: slotted hex. head; #6–40; 5/16″ lg under head threaded full lg.		4T6746
307, 311, 313, 315, 317, 318, 325, 328, 329, 331, 333	SCREW, machine: slotted hex. head #6–40; 5/8″ lg under head threaded full lg.		4T6811
313, 328	SCREW, machine: eccentric; fl top Bind H; steel; #4–40; .281″ lg w/.250″ lg thd.	Adjusts trip-off and intermediate pawls.	4T6942
313	SCREW, machine: eccentric; flat top Bind H; steel	Adjusts transmitter clutch throw-out lever.	4T89917
312	SPRING: loop; key lever; .035″ music wire	Exerts pressure on key levers	4T2565

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR KEYBOARD, TELETYPE PARTS # BK22JK and # BK22KQ—Continued		
313	SPRING: extension; .018″ music wire	Exerts pressure on lock loop	4T2623
312	SPRING: loop; .049″ music wire; 2¼″ x 2⅛″ x 3/16″ h overall.	Exerts pressure on space key lever	4T80392
314	SPRING: compression; .038″ diam music wire; .733″ OD x .637″ lg.	Exerts pressure on driven clutch member of transmitting shaft.	4T80471
313	SPRING: extension; .014″ music wire; ¾″ lg x 11/64″ diam overall.	Exerts pressure on transmitter clutch throw-out lever.	4T90260
313	SPRING: .014″ diam music wire; ⅝″ lg x .149″ diam overall.	Tensions trip-off pawl	4T91120
313	STUD: 23/64″ diam x 1⅜″ lg overall	Clutch lever mounting	4T7386
334	SUPPRESSOR: 2 pieces, open type; consists of 10,000 $\mu\mu$f 500 v ac test capacitor mtd on base and 60 ma 110 v dc filter assembly w/bracket and leads.	Suppresses electrical noise	4T93884
307 through 329; 331, 333 through 337.	WASHER, lock: split ring		4T2191 (superseded, use 6L73006)
	Note. Keytops are arranged in groups for TT–5/FG and conversion to TT–6/FG.		
	KEYTOP, spring cushion:	Function of all keytops is to designate characters and functions resulting from operation of keys.	
330	KEYTOP, spring cushion: (A –)		4T78946
330	KEYTOP, spring cushion: (B ?)		4T78947
330	KEYTOP, spring cushion: (C :)		4T78948
330	KEYTOP, spring cushion: (D $)		4T78949
330	KEYTOP, spring cushion: (E 3)		4T78950
330	KEYTOP, spring cushion: (F !)		4T78951
330	KEYTOP, spring cushion: (G &)		4T78952
330	KEYTOP, spring cushion: (I 8)		4T78954
330	KEYTOP, spring cushion: (J ′)		4T78955
330	KEYTOP, spring cushion: (K ()		4T78956
330	KEYTOP, spring cushion: (L))		4T78957
330	KEYTOP, spring cushion: (M .)		4T78958
330	KEYTOP, spring cushion: (N ,)		4T78959
330	KEYTOP, spring cushion: (O 9)		4T78960
330	KEYTOP, spring cushion: (Q 1)		4T78962
330	KEYTOP, spring cushion: (R 4)		4T78963
330	KEYTOP, spring cushion: (T 5)		4T78964
330	KEYTOP, spring cushion: (U 7)		4T78965
330	KEYTOP, spring cushion: (V ;)		4T78966
330	KEYTOP, spring cushion: (W 2)		4T78967
330	KEYTOP, spring cushion: (X /)		4T78968
330	KEYTOP, spring cushion: (Y 6)		4T78969
330	KEYTOP, spring cushion: (Z ″)		4T78970
330	KEYTOP, spring cushion: (Blank)		4T78971
330	KEYTOP, spring cushion: (FIGS)		4T78972
330	KEYTOP, spring cushion: (LTRS)		4T78973
330	KEYTOP, spring cushion: (CAR RET)		4T78976
330	KEYTOP, spring cushion: (LINE FEED)		4T78978

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR KEYBOARD, TELETYPE PARTS # BK22JK and # BK22KQ—Continued		
330	KEYTOP, spring cushion: (. .)		4T78979
330	KEYTOP, spring cushion: (S BELL)		4T78980
330	KEYTOP, spring cushion: (H-STOP)		4T82607
	KEYTOPS for TT–6/FG (for weather keyboard):		
330	KEYTOP, spring cushion: (–)		4T89413
330	KEYTOP, spring cushion: (A↑)		4T89414
330	KEYTOP, spring cushion: (D↗)		4T89415
330	KEYTOP, spring cushion: (F→)		4T89416
330	KEYTOP, spring cushion: (G↘)		4T89417
330	KEYTOP, spring cushion: (H↓)		4T89418
330	KEYTOP, spring cushion: (J↙)		4T89419
320	KEYTOP, spring cushion: (K←)		4T89420
330	KEYTOP, spring cushion: (L↖)		4T89421
330	KEYTOP, spring cushion: (Z+)		4T89422
330	KEYTOP, spring cushion: (ᵉ◯)		4T89423
330	KEYTOP, spring cushion: (V⏀)		4T89424
330	KEYTOP, spring cushion: (B⊕)		4T89425
330	KEYTOP, spring cushion: (N⏀)		4T89426
330	KEYTOP, spring cushion: (PØ)		4T99564
	PARTS FOR RECTIFIER, TELETYPE PART # Rec29		
338	CABLE ASSEMBLY, power: 2 cond; RC; 30″ lg; approx 3/8″ OD; polarized male plug w/cord clamp one end, leads w/tinned tips other end.	Connects a-c power to rectifier	4T101954
338	CAPACITOR, fixed: paper; 4 uf; +20%–10%; 330 vacw; 3½″ lg x 2 11/16″ wd x 1 3/16″ thk.	Part of filter circuit	4T103615
338	CONNECTOR, male contact: 2 polarized cont; straight; 1¼″ lg x 1 5/8″ dia.	Connects power input	4T72481
338	CONNECTOR, female contact: 3 rectangular polarized cont; straight; 2 3/8″ lg x 1½″ wd overall.	Connects dc to teletypewriter	4T89239
307, 338	FUSE, cartridge: 3.2 amp; 250 v; time lag	Protects input circuit	4T101063
307, 338	FUSE, cartridge: .3 amp; 250 v; 2″ lg x 9/16″ dia overall.	Protects output circuit	3Z2586–2, (same as 4T102701)
338	RECTIFIER, metallic: selenium disk type; 105 to 125 v or 190 to 250 v at 25/60 cyc, single ph; output 120 v dc, .2 amp; 7″ lg x 1½″ dia less terminal.	Adjusts input through transformer	4T105313
338, 339	RESISTOR, fixed: wire wound; 2,000 ohms ±10%; 25 w; 2″ lg x 9/16″ dia; inductive.	Filters dc	3Z6200–75 (supersedes 4T101945)
	PARTS FOR TYPING UNIT, TELETYPE PART #BP22/210 and BP93/221		
	Note. Type bars are arranged in groups for TT–5/FG and conversion to TT–6/FG at end of typing unit group list of parts.		
	PARTS FOR RELAY, TELETYPE PART #TRY30		
322	ARM: .095″ steel, zinc chromate; 1 3/8″ lg x 3/8″ d overall; cir part 1″ OD x 41/64″ ID.	Ribbon reverse backstop	4T110351

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	PARTS FOR RELAY, TELETYPE PART # TRY30—Continued		
337	ARMATURE, relay: w/nickel silver cont on .042" soft iron arm; 3⅜" lg x 3/16" wd x ⅛" thk overall	Operates to furnish mark or space signals.	4T99857
	NUT, hexagon: brass; #3–48; .062" thk x .156" across flats.		4T78337
337	RELAY	Strengthens weak signals	4TRY30
337	SCREW: relay sw; capstan head; brass; #5–40; 7/16" lg w/¼" lg thd; w/platinum cont .062" OD x 5/64" lg; head 5/32" thk x 5/16" OD.	Adjusting screw	4T94092
337	SCREW, capstan: steel; #10–40; 7/16" lg threaded full lg.	Adjusting screw	4T99864
337	TERMINAL, stud: brass; 1 1/16" lg x 3/16" dia overall		4T78881
—	WASHER, lock: .004" steel; #3, 7/32" OD; internal teeth.		4T93002
	MISCELLANEOUS PARTS		
	ARM, reverse: right	Helps reverse ribbon	4T74344
318	ARM: extension; sixth vane; hardened steel, 1.281" lg x .844" wd x .375" thk.	Operates shift vane No. 6	4T82963
328	ARMATURE, electromagnet: steel; selector	Positions swords	4T8508
323, 324	BALL, bearing: spherical; .09375"±.00025" dia	Bearing for carriage roller	4T2451
318	BAR, locking: .065" CRS; nickel finish; 6.437" lg x ⅞" wd x ⅞" h overall.	Used with carriage return	4T74160
320	BAR, code: #1D; steel, zinc chromate; 5⅞" lg x 1 11/16" h x .045" thk.	Selects pull bars for printing	4T74180
320	BAR, code: #2D; steel, zinc chromate; 5⅞" lg x 1 11/16" h x .045" thk.		4T74181
320	BAR, code: #3D; steel, zinc chromate; 5⅞" lg x 1 11/16" h x .045" thk.		4T74182
320	BAR, code: #4D; steel, zinc chromate; 5⅞" lg x 1 11/16" h x .045" thk.		4T74183
	BAR, code: #5D; steel, zinc chromate; 5⅞" lg x 1 11/16" h x .045" thk.		4T74184
323, 330	BAR, pull: .045" steel, nickel finish; std position		4T74185
	BAR, type: w/pallet; steel; 3 15/32" lg x 1 9/64" wd approx overall:	Operated by associated pull bars, type bars cause printing of characters attached to the bars in the form of type pallets.	
330	BAR, type: (. .); stamped "2" (TT–5/FG only)		4T74642
330	BAR, type: (Z"); stamped "3" (TT–5/FG only)		4T74643
330	BAR, type: (K ( ); stamped "4" (TT–5/FG only)		4T74644
330	BAR, type: (B ?); stamped "5" (TT–5/FG only)		4T74645
330	BAR, type: (Y 6); stamped "7"		4T74647
330	BAR, type: (M .); stamped "8"		4T74648
330	BAR, type: (U 7); stamped "9"		4T74649
330	BAR, type: (L)); stamped "10" (TT–5/FG only)		4T74650
330	BAR, type: (H £); stamped "11" (TT–5/FG only)		4T64651
330	BAR, type: (O 9); stamped "12"		4T74652
330	BAR, type: (I 8); stamped "13"		4T74653
330	BAR, type: (N,); stamped "14" (TT–5/FG only)		4T74654
330	BAR, type: (E 3); stamped "15"		4T74655
330	BAR, type: (T 5); stamped "16"		4T74656
330	BAR, type: (A -); stamped "17" (TT–5/FG only)		4T74657
330	BAR, type: (J '); stamped "18" (TT–5/FG only)		4T74658
330	BAR, type: (R 4); stamped "19"		4T74659

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
	BAR, type,: w/pallet, etc.—Continued		
330	BAR, type: (D $); stamped "20" (TT–5/FG only)		4T74660
330	BAR, type: (C :); stamped "21" (TT–5/FG only)		4T74661
330	BAR, type: (F !); stamped "22" (TT–5/FG only)		4T74662
330	BAR, type: (W 2); stamped "23"		4T74663
330	BAR, type: (G &); stamped "24" (TT–5/FG only)		4T74664
330	BAR, type: (V ;); stamped "25" (TT–5/FG only)		4T74665
330	BAR, type: (Q 1); stamped "26"		4T74666
330	BAR, type: (X /); stamped "27"		4T74667
330	BAR, type: (S '); stamped "28"		4T74668
330	BAR, type: #6; (PØ)		4T102985
	BAR, type: for TT–6/FG (for weather keyboard):		
330	BAR, type: #2; (–) (TT–6/FG only)		4T84734
330	BAR, type: #3; (Z ×) (TT–6/FG only)		4T84735
330	BAR, type: #4; (K ←) (TT–6/FG only)		4T84736
330	BAR, type: #5; (B ⊕) (TT–6/FG only)		4T84737
330	BAR, type: #10; (L ↖) (TT–6/FG only)		4T84738
330	BAR, type: #11; (H ↓) (TT–6/FG only)		4T84740
330	BAR, type: #14; (N ⦶) (TT–6/FG only)		4T84742
330	BAR, type: #17; (A ↑) (TT–6/FG only)		4T84743
330	BAR, type: #18; (J ↙) (TT–6/FG only)		4T84745
330	BAR, type: #20; (D ↗) (TT–6/FG only)		4T84746
330	BAR, type: #21; (C ◯) (TT–6/FG only)		4T84747
330	BAR, type: #22; (F →) (TT–6/FG only)		4T84749
330	BAR, type: #24; (G ↘) (TT–6/FG only)		4T82750
330	BAR, type: #25; (V ⦶) (TT–6/FG only		4T84752
317	BEARING, ball: single row radial; .4724″ ID, 1.2598″ OD x .3937″ wd.	Part of main-shaft mounting	4T74899
317	BEARING, ball: steel .315″ ID x 1.0236″ OD x .315″ thk.	Mounting in main shaft assembly	4T72644
320	BEARING, roller: w/pilot screw; .703″ lg x .500″ OD overall.	Cam follower roller assembly for printing bail arm.	4T91175
321	BEARING, sleeve: head type; .249″ lg overall	Mounts function lever roller	4T93757
315	BEARING, sleeve: CHS; ⅝″ lg x 1¼″ max dia overall.	Bail shaft bearing	4T74119
320	BEARING, sleeve: eccentric; $\frac{5}{32}$″ lg overall	Pivot for bell cranks	4T74199
	BEARING ASSEMBLY, ball: steel; operating bail roller; .508″ dia x .719″ lg overall.	Rides surface of printing bail cam	4T74368
328	BRACKET: armature; L and U shape combinations	Mounts selector armature	4T6884
323	BUMPER: leather; 5.875″ lg x .438″ wd x .125″ thk overall.	Type bar backstop	4T74279
312	BUFFER, rubber: stem type; black head; ½″ dia x $\frac{3}{32}$″ thk; stem $\frac{3}{16}$″ dia x ¼″ lg	Cushions keyboard frame	4T2663
320	BUSHING: steel; .221″ dia x .051″ thk; double chamfered.	Spacer for code bar	4T6859
317	CAM ASSEMBLY: sleeve; steel, solder dipped; $\frac{29}{32}$″ lg x $\frac{13}{16}$″ OD x $1\frac{7}{32}$″ h overall.	Main keyboard shaft cam	4T8507
328	COIL, solenoid: electromagnet; selector	Receives electrical impulses to operate selector mechanism.	4T177M
338	CONNECTOR, male contact: 2 flat polarized cont; straight; 1¼″ lg x 1⅝″ dia less cont.	Input cord in Rec–29 power supply	4T72481
308, 327	CONTACT, switch: phosphor bronze; bakelite insulated tip, copper cont; $2\frac{23}{32}$″ lg x $\frac{11}{32}$″ wd x $\frac{17}{64}$″ h overall (TT–5/FG only).	In motor control and motor-stop, and send-receive mechanism	4T73593

Fig. No.	Name of part and descrition	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
308, 327	CONTACT, switch: phosphor bronze, copper cont; 2⅜″ lg x ¼″ wd x 1/64″ h overall (TT–5/FG only).	Control in motor control and motor-stop, and send-receive mechanism.	4T73588
325	CRANK: hand; 3 43/64″ lg x .547″ thk x 2 25/64″ h overall.	Turns platen	4T80466
317	DISK, clutch: .938″ dia x .049″ thk overall	Disk for selector cam sleeve friction clutch.	4T6863
317	DISK, clutch: CHS, zinc chromate	Part of driving selector cam sleeve	4T72513
317	DISK, retainer: CHS; zinc chromate; .938″ max dia x .438″ lg overall.	Used with cam sleeve	4T72516
328	ECCENTRIC: .562″ lg x .250″ dia w/#4–40 thd; shank .281″ lg, threaded 3/16″.	Adjustable stop	4T6966
315, 320	FITTING: 90° elbow; ⅝″ lg x 7/16″ wd x 9/16″ h overall; shank ¼″–32 thd, ¼″ lg thd; cap hinged at side, body ¼″ dia.	Lubrication fitting	4T86710
318	FORK, clutch: hardened steel, zinc chromate; U shape, 2″ lg x 1 1/32″ wd x .942″ thk overall, .812″ ID.	Part of carriage release mechanism	4T74071
317	GEAR: clutch; steel; 7.50″ dia x .125″ thk overall; 16 teeth.	Driving gear	4T72562
317	GEAR: clutch; steel; .938″ OD x .781″ lg overall; 16 teeth.	Driven gear	4T74502
317, 331	GEAR: helical; fiber; 35-tooth	Driven gear of worm gear set	4T74151
317	GEAR: helical; steel; 56° rh angle; 21-tooth	Keyboard drive gear	4T74596
326	GUIDE: steel, zinc chromate; rh side; irregular shape; 2⅞″ lg x 1 5/16″ wd overall.	Guides paper	4T74469
326	GUIDE: steel, zinc chromate; lh side; 2⅞″ lg x 1 9/32″ wd x 1″ thk overall.	Guides paper	4T74470
323	GUIDE: zinc chromate; .028″ CRS; 2″ lg x 1⅛″ wd x 13/32″ thk overall.	Guides ribbon	4T74371
322	HOLDER, spring: brass; zinc chromate; 15/32″ lg x ⅜″ and 7/16″ d overall.	Fastens springs	4T110350
332	HOLDER, contact brush: bakelite bushing w/brass insert; 1 7/16″ lg x 25/64″ dia overall.	Brush holder in 77953 motor	4T70872
328	LATCH, lever: tool steel; zinc plate and chromate dip; .328″ wd x .485″ d x .533″ h overall.		4T74009
318	LATCH, lever: steel, nickel finish; 1 11/32″ lg x ⅞″ wd x .344″ thk overall; .065″ thk stock.	Operates lock bar	4T74161
329	LEVER: selector sword; steel	Positions selector levers	4T6685
328	LEVER: .969″ lg x .125″ wd x .180″ h overall	Trip latch for rangefinder	4T6830
328	LEVER: selector cam sleeve; 55/64″ lg x 25/64″ wd x 13/32″ d overall.	Stops rotation of selector cam sleeve on stop impulse.	4T6909
329	LEVER: clutch throw-out; 1.634″ lg x .578″ wd x 1.384″ h overall.	Controls rotation of printing bail cam and junction bail cam.	4T6971
329	LEVER: right side selector; 1.468″ lg x 1.271″ wd x .45″ thk overall.	Carries sword for positioning	4T8157
329	LEVER: left side selector; 1.641″ lg x 1.068″ h x .045″ thk overall.	Carries sword for positioning	4T8158
329	LEVER: tool steel; 1.948″ lg x 1 1/32″ wd x .050″ thk overall.	Locks magnet armature	4T8511
315	LEVER: steel; 2.109″ lg x .688″ h x .625″ wd overall	Platen shift lever	4T74058
318	LEVER: steel; zinc chromate; 2 3/16″ lg x 1″ wd x .862″ thk overall, made from .065″ thk stock.	Operating latch and reset bar	4T74072
329	LEVER: code-bar selector; stamped #1; CRS; T shape; .822″ lg x .812″ wd x .145″ thk overall.		4T74133

2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
329	LEVER: code-bar selector; stamped #2; CRS; T shape.	Positions vanes	4T74134
329	LEVER: code-bar selector; stamped #3; CRS; T shape.		4T74135
329	LEVER: code-bar selector; stamped #4; CRS; T shape.		4T74136
329	LEVER: code-bar selector; stamped #5; CRS; T shape.		4T74137
325	LEVER: .095″ CRS, zinc chromate; 2.140″ x 2.031″ x 13/32″ h overall.	Part of LINE FEED mechanism	4T74465
322	LEVER: left; .050″; 2.482″ lg x 1.875″ wd x 1.670″ h overall.	Part of ribbon reverse mechanism	4T93167
318, 319, 323, 324, 329	NUT, hexagon: 1/4″–32; 3/32″ thk; 7/16″ across flats		4T34–1
318, 319, 323, 324, 329	NUT, hexagon: #2–56; 1/16″ thk; 3/16″ across flats		4T34–11
318	NUT, hexagon: #6–40; 5/32″ thk; 1/4″ across flats		4T34–51
313, 318, 325, 327, 328, 335	NUT, hexagon: #4–40; 1/16″ thk; 1/4″ across flats		4T34–56
314	NUT, hexagon: 7/16″–32; 1/8″ thk; 9/16″ across flats	Secures transmitting shaft to mounting bracket.	4T2199
322	NUT, hexagon: 5/16″–32; 1/8″ thk; 7/16″ across flats	Secures ribbon spool assembly	4T2201
	NUT, hexagon: #6–40; 3/32″ thk; 1/4″ across flats		4T3598
309, 312, 314, 323, 324, 327	NUT, hexagon: #4–40; 3/32″ thk; 3/16″ across flats		4T3599
315, 320	NUT, hexagon: 1/4″–32; 1/16″ thk; 5/16″ across flats		4T3603
312, 320, 324	NUT, hexagon: #6–40; 1/16″ thk; 1/4″ across flats		4T3606
328	NUT, hexagon: brass; #6–40; 5/16″ thk overall; .375″ across flats, .301″ thk.	Locknut in selector unit	4T71045
	NUT, shoulder: steel, zinc chromate; 5/16″–32 lh thd; .094″ thk; 3/4″ across flats.		4T72515
313, 314	NUT, hexagon: steel, #10–32; .094″ thk x .250″ across flats.		4T89887
324	NUT, hexagon: steel; #10–32; .094″ thk; .312″ wd across flats.		4T74807
325	PAWL, ratchet: steel, hardened, nickel finish; 1.125″ lg x .320″ wd x .312″ thk overall.	Operates line feed	4T74467
318	PIN, cotter: steel; .047″ dia x 27/64″ lg overall		4T80516
329	PLATE: 18% nickel silver; 25/8″ x 27/64″ x .0159″ thk overall.	Spacer in top selector plate	4T83920
329	PLATE, spacer: 211/16″ lg x 2.141″ wd x .065″ thk	Guides selector levers and selector swords.	4T6689
325	PLATEN, rubber: 927/64″ lg x 13/4″ OD overall	Roll against which paper is printed on.	4T74438
317	PLUG, machine thread: steel, zinc chromate	Used with main drive shaft	4T74101
328	PLUNGER: pin type; steel; .455″ lg x .099″ dia overall; shank .077″ dia x .424″ lg.	Is operated by armature trip-off eccentric screw to operate trip-off bell crank.	47007
318, 321, 324	POST, anchor: friction spring, 1/8″ dia x 11/32″ lg; one end tapered to 3/32″ dia, 5/32″ lg, other end undercut.	Mounts spring	4T6940

2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
320	POST, anchor: spring; 1/4″ across flats x 23/32″ lg overall.	Function bail spring post	4T85709
334	RESISTOR, fixed: wire wound; 8000 ohms ±10%; 15w; 2″ lg x 1/2″ body dia x .277″ ID.	Limits current in bias circuit for 20 ma line current operation.	4T99744
324	ROLLER ASSEMBLY, lever: detent; 2 3/16″ lg x 7/16″ wd x 9/32″ h overall.	Ribbon reverse shaft detent	4T74754
325	ROLLER, guide: steel; 5/32″ ID, 7/32″ OD x 1/4″ lg	Detent guide	4T74481
326	ROLLER: rubber; 1/2″ dia x 1 11/32″ lg; brass insert 5/32″ ID, 7/32″ OD x 1 1/2″ lg.	Front pressure guide	4T74490
326	ROLLER: rubber; 9/16″ dia x 1 11/32″ lg; brass insert 5/32″ ID, 7/32″ OD x 1 1/2″ lg.	Rear pressure guide	4T74491
323	ROLLER, lever: steel; ground and polished; .095″ ID, .438″ OD x .154″ thk.	Controls ribbon	4T74010
321	ROLLER, lever: 4.359″ lg overall	Function lever return	4T93755
324	SCREW, shoulder: spcl head, slotted; #10–32; .529″ lg w/.437″ lg thd; shoulder .092″ lg x .248″ OD.		4T84896
328	SCREW: approx 1 5/32″ lg x 1/2″ dia	Spring tension adjusting screw	4T74724
315	SCREW, pilot: slotted hex. head; CHS; #10–32; .750″ lg w/.703″ lg thd; pilot .125″ dia x .047″ lg.		4T83884
	SCREW, machine: FH		4T33–11
	SCREW, set: Fil H; steel, zinc chromate; #6–40; 15/32″ lg w/11/32″ lg thd; hanger point 1/8″ lg.	Platen setscrew	4T74517
322, 325, 326	SCREW, set: F Fil H; CHS, nickel finish; #6–40; .156″ lg under-head; threaded full lg.		4T74536
325	SCREW, shoulder: flat top Bind H; #10–32; 9/16″ lg w/3/8″ lg thd.		4T74566
318, 323, 326	SCREW, shoulder: cheese head; #6–40; 11/32″ lg under head w/9/32″ lg thd.		4T1196
318, 319	SCREW, machine: Fil H; #10–32; 5/8″ lg under head threaded full lg.		4T1208
310, 318	SCREW, machine: Fil H; #6-40; 3/4″ lg under head threaded full lg.		4T1226
319, 325	SCREW, machine: FH; #6–40; 1/2″ lg w/29/64″ lg thd		4T1248
326	SCREW, machine: Fil H; #6–40; 1/2″ lg under head; threaded full lg.	In paper friction feed mechanism	4T1269
318	SCREW, machine: stop, hex. head; #6–40; 31/32″ lg w/9/16″ lg thd.		4T91600
307, 321, 326, 334	SCREW, machine: hex. H; steel; zinc chromate; #6–40; 7/32″ lg under head; head 1/4″ across flats x 3/32″ thk.		4T74059
307, 311, 321, 334	SCREW, machine: hex. head; steel, nickel finish; #10–32 thd; 3/4″ lg.		4T74014
320	SPRING: extension; .063″ music wire; 1 45/64″ lg x 5/8″ dia overall.	Tensions printing and function bail parts.	4T74015
325	SCREW, shoulder: eccentric; spcl head; #6–40 thd; 17/32″ lg w/1/4″ lg thd.		4T74020
312, 315, 317, 320, 323	SCREW, machine: slotted hex. head; #6–40; 13/32″ lg w/13/32″ lg thd.		4T74986
327	SCREW, machine: Fil H; steel; #2–56; 1/2″ lg under head w/7/16″ lg thd.		4T1222
	SCREW, machine: Fil H; #4–40; 21/64″ lg under head w/11/64″ lg thd.		4T80255

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.[1]
	MISCELLANEOUS PARTS—Continued		
324	SCREW, shoulder: cheese head; #6–40; 3/16″ lg w/1/8″ lg thd.	Connects ribbon reverse link to ribbon reverse pawl and ribbon reverse shaft link.	4T–1010
310, 319, 321, 325	SCREW, machine: Fil H; steel; zinc chromate; #6–40; 3/8″ lg under head threaded full lg.	------------------------------	4T1026
307 through 310; 315, 316, 320, 323, 324, 327	SCREW, machine: slotted hex, head; #10–32; 1/2″lg	------------------------------	4T6745
307, 310, 312, 313 through 316; 318, 319, 321, 323, 324, 327, 328, 329, 331	SCREW, machine: slotted hex. head: #6–40; 5/16″ lg under head threaded full lg.	------------------------------	4T6746
321	SHIM: steel; 13/16″ x 1/4″ x .005″ thk	Adjusts function levers	4T6760
328	SCREW, shoulder: F Fil H, chamfered; #6–40; .843″ lg w/.437″ lg thd.	Mounts stop lever on range-finder	4T6799
315, 316, 318, 324, 325	SCREW, shoulder: flat top Bind H; #6–40; 3/8″ lg w/1/4″ lg thd.	------------------------------	4T6800
321	SCREW, pivot; spcl slotted head; steel, nickel finish; #10–32; 7/8″ lg w/11/16″ lg thd.	------------------------------	4T74170
318	SCREW, shoulder: eccentric; flat top Bind H; hardened steel; chromate; #6–40; 1/2″ lg w/3/16″ lg thd.	------------------------------	4T74171
315	SCREW, shoulder: eccentric; flat top Bind H; hardened steel; zinc chromate; #10–32; 1 1/16″ lg w/1/4″ lg thd.	------------------------------	4T74172
328	SCREW, pilot: cheese head; #4–40; 19/64″ lg w/1/16″ lg thd.	Mounts trip latch on range-finder	4T6801
307, 308, 311, 315, 316, 319, 327	SCREW, machine: slotted hex. head; #10–32; 3/8″ lg threaded full lg.	------------------------------	4T6810
307, 311, 313, 315, 317, 318, 325, 328, 329, 331, 333	SCREW, machine: slotted hex. head; #6–40; 5/8″ lg under head threaded full lg.	------------------------------	4T6811
329	Screw, pilot: hex. head; 1/4″–32; .594″ lg w/.407″ lg thd; .031″ lg x .209 dia shoulder and pilot .156″ lg x .155″ dia.	Main shaft throw-out lever pilot screw.	4T6990
323	SCREW, pilot: Fil H; steel , spcl finish; #6–40; 19/32″ lg w/1/4″ lg thd.	------------------------------	4T74296

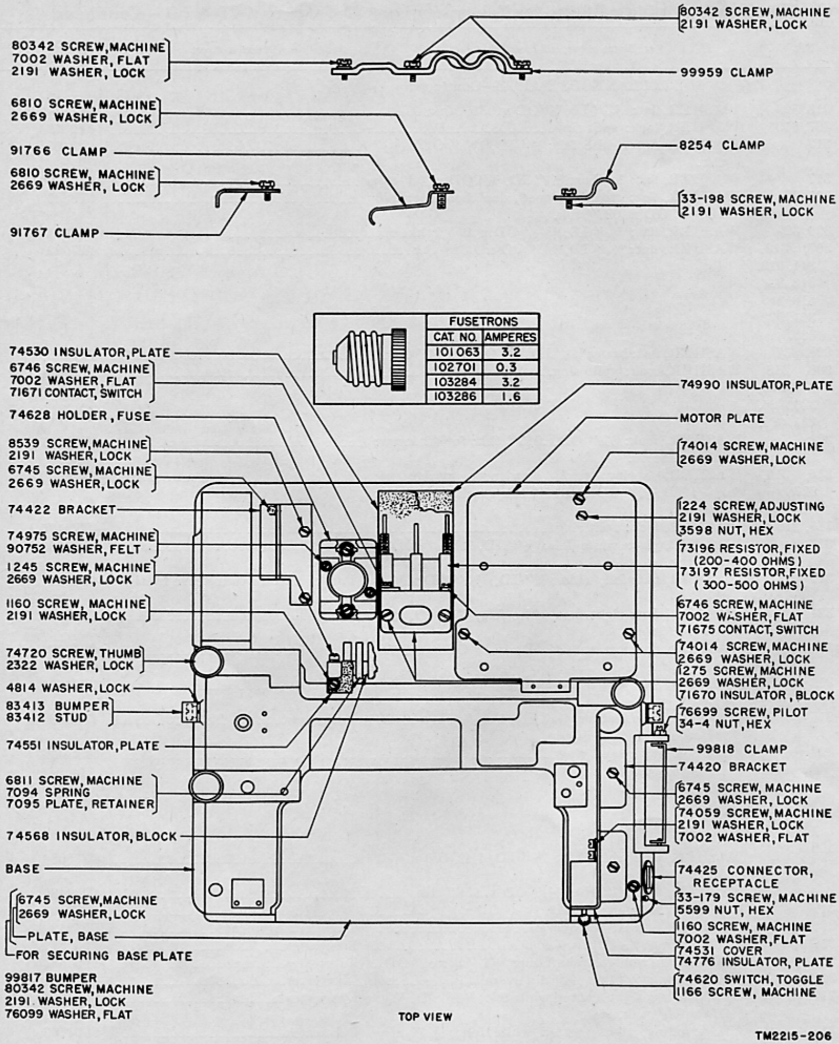
Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
328	SCREW, machine: round V-milled head; drill rod steel, zinc chromate; #2–56; .188″ lg w/.188″ lg thd.	In selector unit pulling magnet	4T8472
325	SCREW, shoulder: cheese head; zinc chromate, #6–40; .629″ lg w/$\frac{3}{8}$″ lg thd; shoulder .187″ OD x 254″ lg.		4T74361
313, 328	SCREW, machine: eccentric; flat top Bind H; #4–40: 281″ lg w/.250″ lg thd.		4T6942
	SCREW, machine: slotted hex. head; steel, nickel finish; #6–40 $\frac{1}{2}$″ lg under head.		4T8539
325	SCREW, pilot: Fil H; #4–40; .422″ lg w/.135″ lg thd	In platen assembly	4T7678
329	SCREW, pilot: hex. head; steel; nickel finish; #6–40; $\frac{25}{32}$″ lg w/$\frac{5}{32}$″ lg thd; head $\frac{3}{32}$″ thk x $\frac{1}{4}$″ across flats; pilot $\frac{3}{32}$″ dia x $\frac{9}{16}$″ lg.		4T74399
326	SCREW, machine: Bind H; #6–40; $\frac{1}{4}$″ lg under heads		4T8543
328	SCREW, pivot: headless w/screw driver slot; #6–40; .307″ lg x .137″ dia overall; thd $\frac{7}{32}$″.		4T70803
328	SCREW, brass: hex.; #6–40 class 3 fit x $\frac{7}{16}$″ lg on ea end; $\frac{15}{16}$″ lg overall; hex. center $\frac{1}{32}$″ thk x $\frac{3}{8}$″ across flats, shoulder $\frac{1}{32}$″ wd x $\frac{3}{8}$″ dia.	Adjusting screw	4T71046
326	SCREW, machine: slotted hex. head; #4–40; $\frac{1}{4}$″ lg under head threaded full lg.		4T74613
324	SCREW, machine: flat top Bind H; CHS; #6–40; $\frac{5}{8}$″ lg under head w/$\frac{1}{2}$″ lg thd.		4T74687
310, 328	SCREW, machine: Bind H; #4–40; $\frac{1}{4}$″ lg under head w/.219″ lg thd.		4T1028
328, 335	SCREW, shoulder: cheese head; #6–40; $\frac{11}{32}$″ lg w/$\frac{1}{4}$″ lg thd.		4T1030
327	SCREW, machine: Fil H; brass, #4–40; $\frac{15}{32}$″ lg under head threaded full lg.		4T1097
307, 315, 318, 320, 321, 328	SCREW, machine: Fil H; #6–40; $\frac{5}{16}$″ lg threaded full lg.		4T1160
315, 323, 325, 327	SCREW, machine: Fil H; #6–40; $\frac{1}{4}$″ lg under head; threaded full lg.		4T1161
323, 324, 326, 327	SCREW, machine: Fil H; #4–40; $\frac{1}{4}$″ lg under head; threaded ful lg.		4T1162
309, 316, 323, 324, 333	SCREW, machine: Fil H; #4–40; $\frac{5}{16}$″ lg under head w/$\frac{9}{32}$″ lg thd.		4T1168
308, 322, 326	SCREW, machine: Fil H; #6–40; $\frac{3}{16}$″ lg threaded full lg.		4T1176
313, 318, 320	SHIM: cont mtg; .140″ ID, $\frac{5}{16}$″ OD x .005″ thk		4T8896
323	SPRING: extension; .030″ dia music wire; $\frac{23}{32}$″ lg x $\frac{3}{16}$″ dia overall.		4T74700
327	SPRING: compression; .011″ dia music wire; $\frac{5}{16}$″ lg x $\frac{1}{8}$″ dia overall.		4T74703
315	SPRING: extension; .056″ dia music wire; $2\frac{11}{32}$″ lg x $\frac{17}{64}$″ dia overall.		4T74704
330	SPRING: extension: .035″ dia music wire; $\frac{63}{64}$″ lg x $\frac{13}{64}$″ dia overall.		4T74705
	SPRING: extension; .030″ dia music wire; $1\frac{3}{16}$″ lg x $\frac{3}{16}$″ dia overall.		4T74706
315	SPRING: extension; .020″ dia music wire; $1\frac{15}{32}$″ x $\frac{11}{64}$″ dia overall.		4T74707

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
326	SPRING: extension; .0335″ dia music wire; $2\frac{7}{32}$″ lg x $\frac{13}{64}$″ dia overall.	----------	4T74708
326	SPRING: extension; .020″ dia music wire; 1.219″ lg x .177″ OD overall.	----------	4T74709
325	SPRING: extension; .063″ dia music wire; $1\frac{7}{16}$″ lg x $\frac{13}{64}$″ dia overall.	----------	4T74710
315	SPRING: extension; .022″ dia music wire; $1\frac{1}{4}$″ lg s $\frac{13}{64}$″ dia overall.	----------	4T74712
322	SPRING: torsion; .030″ dia music wire; 1.344″ lg x $\frac{7}{16}$″ wd overall; .188″ OD coil.	Tensions ribbon reverse arm	4T107273
322	SPRING: torsion; .030″ dia music wire; 1.344″ lg x $\frac{7}{16}$″ wd overall; .188″ OD coil.	----------	4T107274
317	SPRING: compression: .068″ dia music wire; $\frac{33}{64}$″ lg x $\frac{3}{4}$″ dia overall.	Adjustment in main shaft assembly.	4T72514
330	SPRING: extension; .027″ dia music wire; $\frac{61}{64}$″ lg x $\frac{3}{16}$″ dia overall.	----------	4T86873
	SPRING: extension; .018″ dia music wire; $\frac{5}{8}$″ lg x $\frac{3}{16}$″ dia overall.	----------	4T76295
318	SPRING: extension; .035″ dia music wire; 1.670″ lg x .257″ dia overall.	----------	4T76296
329	SPRING: extension; .0165″ dia music wire; $\frac{9}{32}$″ lg x $\frac{1}{8}$″ dia overall.	----------	4T78824
318	SPRING: extension; .024″ dia music wire; 1.230″ lg x .195″ dia overall.	----------	4T80848
320	SPRING: extension; .035″ dia music wire; $2\frac{3}{32}$″ lg x $\frac{21}{64}$″ dia overall.	----------	4T80926
325	SPRING: extension; .016″ dia music wire; .600″ lg x .150″ dia overall.	----------	4T80945
316	SPRING: extension; .022″ dia music wire; $\frac{55}{64}$″ lg x $\frac{7}{32}$″ dia overall.	----------	4T82442
325	SPRING: extension; .013″ dia music wire; $\frac{5}{8}$″ lg x $\frac{5}{32}$″ dia overall.	----------	4T82463
328	SPRING: compression; .012″ dia music wire; $\frac{13}{64}$″ lg x $\frac{9}{64}$″ dia overall.	Aids rangefinder adjustment	4T7602
328	SPRING: extension; .014″ dia music wire; $\frac{29}{64}$″ lg x $\frac{5}{32}$″ dia overall.	Same as item above	4T7603
328	SPRING: extension; .018″ dia music wire; $1\frac{27}{64}$″ lg x $\frac{13}{64}$″ dia overall.	Part of rangefinder	4T7612
329	SPRING: extension; .020″ dia overall. .775″ lg x .133″ dia overall.	In selector unit assembly	4T7614
329	SPRING: extension; .020″ dia music wire; 1″ lg x $\frac{7}{32}$″ dia overall.	Same as item above	4T7615
323, 324, 330	SPRING: extension; .014″ dia music wire; $1\frac{5}{32}$″ lg x $\frac{11}{64}$″ dia overall.	In type bar carriage and type bar segment assemblies.	4T7634
309	SPRING: extension; .010″ music wire; $\frac{5}{8}$″ lg x .130″ dia overall.	Tensions break lever	4T35–70
319	SPRING: motor; .020″ clock spring steel; $\frac{3}{8}$″ wd; $2\frac{7}{8}$″ dia x $\frac{3}{8}$″ thk overall including shipping clamp.	Tensions CAR RET mechanism	4T74272
320	SPRING: extension; .024″ dia music wire; $1\frac{1}{4}$″ lg x $\frac{3}{16}$″ dia overall.	----------	4T74760
325	SPRING: flat; tool steel, annealed; .524″ lg x .532″ wd x .136″ thk overall.	LINE FEED regulator stud retainer.	4T74480
327	SPRING: extension; .012″ dia music wire; $1\frac{7}{64}$″ lg x $\frac{15}{16}$″ dia overall.	----------	4T74988

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
330	SPRING: extension; .030" dia music wire; 1" lg x 3/16" dia overall.		4T74961
330	SPRING: extension; .024" dia music wire; 57/64" lg x 3/16" dia overall.		4T74962
317	SPRING: compression; .055" dia music wire; .740" lg x .890" dia overall.	Exerts pressure on main shaft clutch driven member.	4T6993
317	SPRING: compression; .067" dia music wire; 1 1/4" x .853" dia overall.		4T74152
319	SPRING: extension; .0185" dia music wire; 17/32" lg x 1/8" dia overall.		4T74882
318	SPRING: compression; .014" dia music wire; 9/32" lg x 3/16" dia overall.		4T82965
324	SPRING: extension; .013" music wire; 9/16" lg x 5/32" dia overall.	Tensions ribbon reverse pawl	4T4703
327	SPRING: extension; .010" dia music wire; 33/64" lg x 1/8" dia overall.		4T84575
323	SPRING: extension; .010" dia music wire; 17/32" lg x 9/64" dia overall.		4T82999
326	SPRING: extension; .016" dia music wire; 1/2" lg x 5/32" dia overall.	Tensions paper roll assembly	4T45104
326	SPRING: extension; .020" music wire; 47/64" lg x 11/64" dia overall.	In spindle and paper roll mechanism.	4T55063
318	SPRING: extension; .035" dia music wire; 1 23/64" lg x 11/16" dia overall.	Tensions CAR RET mechanism	4T55088
319	STRAP: black cotton webbing; 9 7/8" lg x 11/32" wd x 3/32" thk overall.	Part of carriage return mechanism	4T74359
320	STUD: steel; 9/32" dia x 29/32" lg overall	Mounts code bar	4T74689
309, 310, 313, 314, 316, 323 through 328; 333 through 336.	WASHER, lock: split ring		4T3640
307 through 311; 315 through 321; 323 through 325; 327, 331, 333.	WASHER, lock: split ring		4T2669
331, 338, 339.	WASHER, flat: 17/64" ID, 5/8" OD x .052" thk		4T2846
308, 310, 319, 321, 333, 334, 335, 339.	WASHER, flat: 3/16" ID, 7/16" OD x .053" thk		4T3438
308, 325, 334	WASHER, lock: split ring, #8, 11/64" ID, 17/64" OD x 1/32" thk.		4T3646
328	WASHER, flat: steel, zinc chromate; #2, 5/64" ID, 13/64" OD x .020" thk.		4T71073
309, 323, 324, 325, 326, 335, 336	WASHER, flat: steel, zinc chromate: #4; 7/64" ID, 1/4" OD x .035" thk.		4T103-27

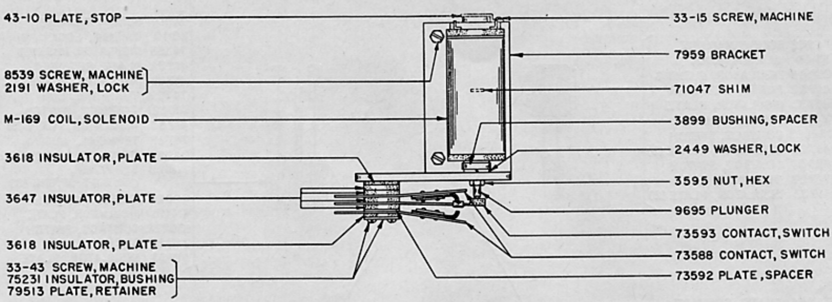
2. Identification Table of Parts for Teletypewriters TT–5/FG and TT–6/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps Stock No.
	MISCELLANEOUS PARTS—Continued		
318, 326	WASHER, flat: 9/64″ ID, 3/8″ OD x .036″ thk		4T123–244
307, 319	WASHER, lock: split ring		4T2322
317	WASHER, flat: white felt; 1/2″ ID, 1 5/16″ OD x 9/64″ thk.		4T74085
317	WASHER, flat: leather; 3/16″ ID, 3/8″ OD x 1/16″ thk		4T74100
325, 331	WASHER, flat: steel, hardened, zinc chromate; .170″ ID, 1/4″ OD x .037″ thk.		4T8330
320, 329	WASHER, flat: 9/64″ ID, 15/64″ OD x .055″ thk		4T7001
307, 310, 311, 312, 313, 314, 316, 318, 321, 322, 323.	WASHER, flat: 9/64″ ID, 5/16″ OD x .032″ thk		4T7002
328, 337	WASHER, flat: brass; 7/64″ ID, 1/4″ OD x .034″ thk		4T2438
308, 315, 318, 320, 323, 324, 331, 339.	WASHER, lock: split ring		4T2449
328	WASHER, lock: 3/16″ OD, .010″ thk; for #2 screw; internal teeth.		4T90791
315, 316, 327.	WASHER, spring: steel, hardened, parkerized; 13/64″ ID, 3/8″ OD x .010″ thk stock; .025″ thk overall.		4T74283
315, 316	WASHER, lock: split ring		4T73175
317	WASHER, flat: white felt; 1/2″ ID, 1 11/64″ OD x 9/64″ thk.		4T74800
317	WASHER, flat: felt, white; 1/4″ ID, 15/16″ OD x 1/16″ thk.	Part of selector cam sleeve friction clutch.	4T6861
321	WASHER, flat: tight mat white felt; 7/64″ ID, 5/16″ OD x 1/8″ thk.		4T93758
320	WASHER, flat: brass; 9/64″ ID, 17/32″ OD x .0205″ thk.	Spacer for code bars	4T6987
315	WASHER, flat: soft white felt; 7/64″ ID, 13/32″ OD x 1/8″ thk.		4T94694
315	WASHER, cup: leather, 3/16″ ID, 1 11/32″ OD x .032″ thk stock 1 5/32″ ID of cup.	In dashpot	4T4033
307 through 329; 331, 333 through 337	WASHER, lock: split ring		6L73006 (supersedes 4T2191)
325	WASHER, flat: white felt; 9/16″ ID, 1 1/4″ OD x 1/16″ thk.		4T76084
	WASHER, flat: 3/16″ ID, 11/32″ OD x .036″ thk		4T34432
317	WASHER, flat: felt; 1/2″ ID, 11/16″ OD x 1/16″ thk		4T72563
320	WICK: 3/8″ lg x 1/8″ dia overall	Oiling arrangement	4T4812
317	WICK: oiling; 3/32″ dia x 3/16″ lg	Lubricates	4T89881
320	WICK: white wool felt; shaft oiler; 19/64″ lg x 1/8″ OD	Lubricates	4T94693
317	WICK: oiling; 1/4″ lg x 3/32″ dia overall	Lubricates	4T72521
317	WICK: oiling; tight matted white felt; 13/32″ ID, 39/64″ OD x 15/64″ thk.	Lubricates	4T74755
317	WICK: oiling; tight matted white felt; 17/32″ ID, .728″ OD x 15/64″ thk.	Lubricates	4T74756

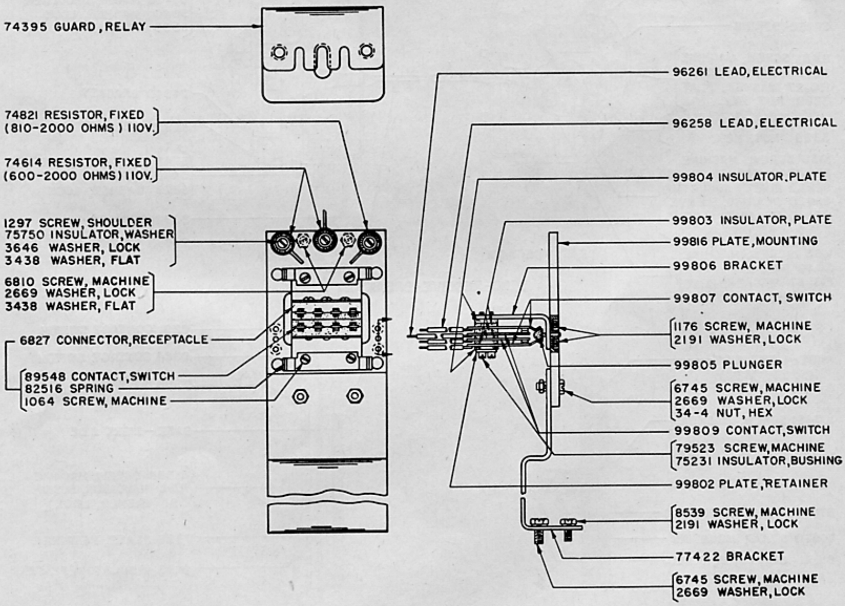


CAT. NO.	AMPERES
101063	3.2
102701	0.3
103284	3.2
103286	1.6

Figure 307. Base, parts identification.



72484 RELAY, SOLENOID: MOTOR CONTROL



LINE RELAY BRACKET PARTS

TM2215-207

Figure 308. Motor control and relay bracket assembly, parts identification.

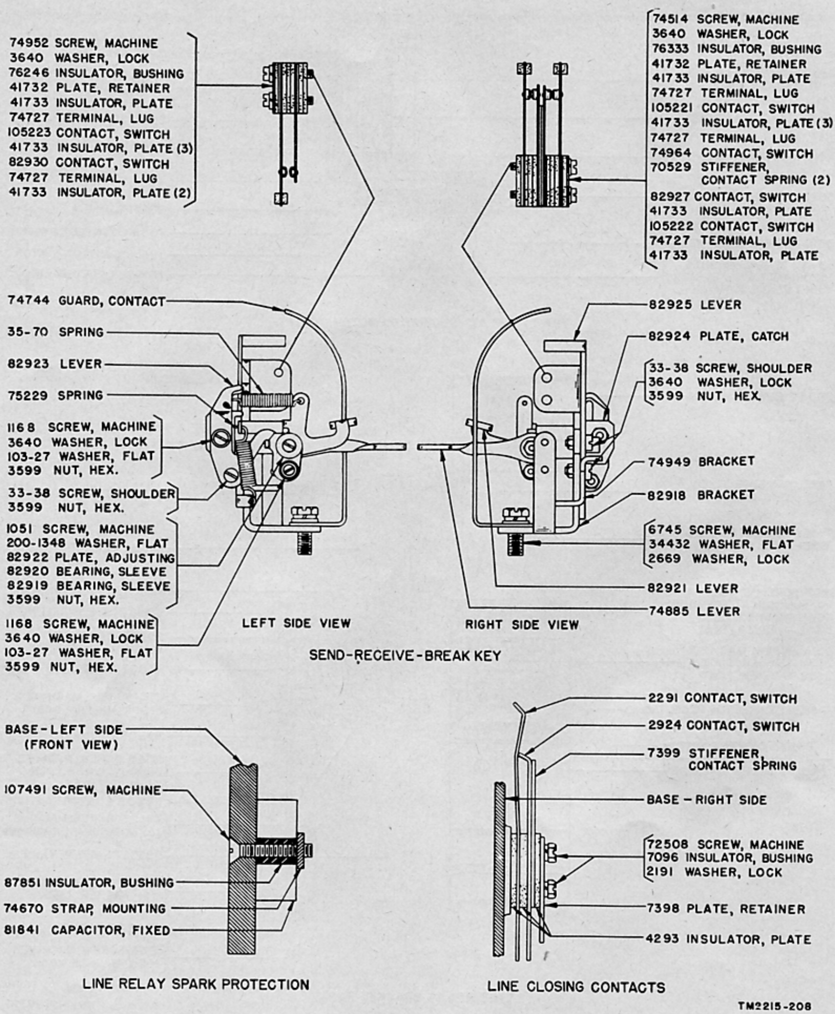


Figure 309. SEND REC BREAK key assembly, line-relay spark protection, and line closing contacts, parts identification.

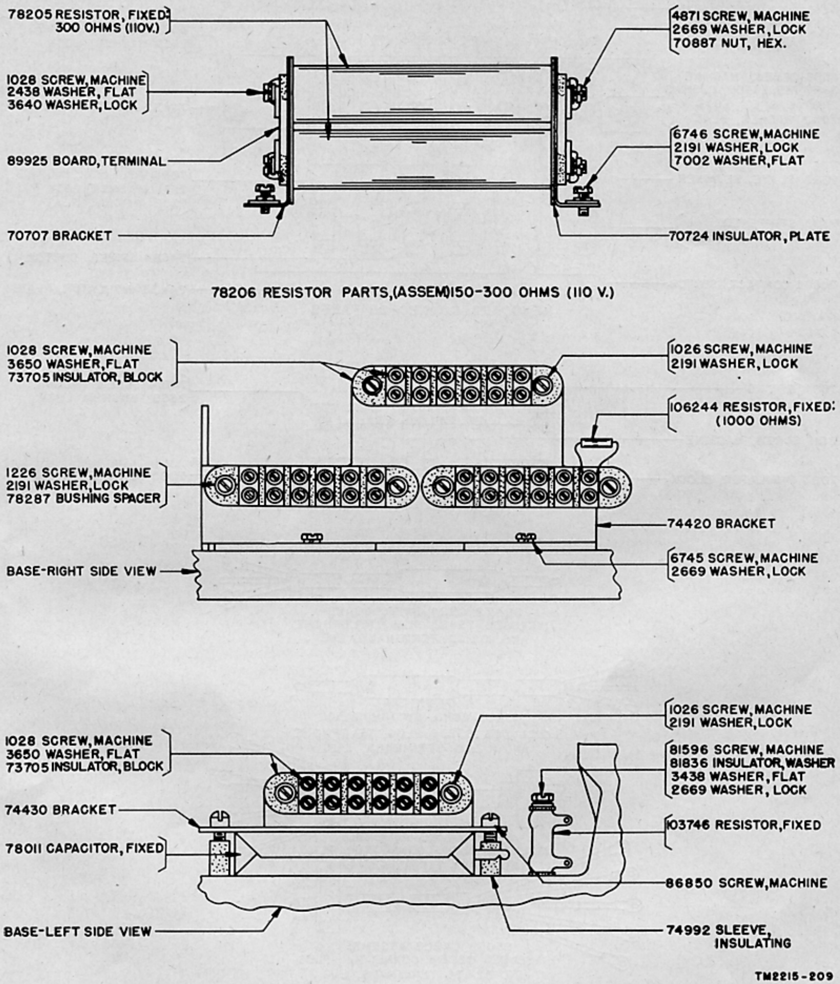


Figure 310. Resistor assembly and terminal board assembly, parts identification.

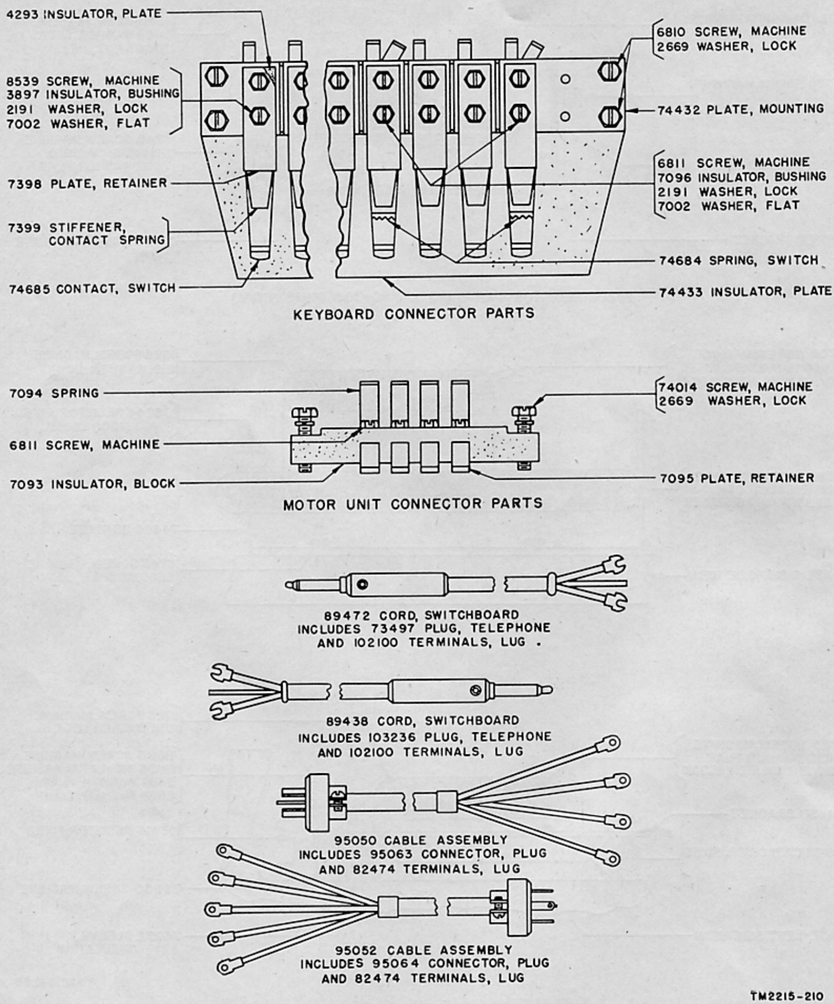


Figure 311. Keyboard, motor unit connector, and cable and cord assemblies, parts identification.

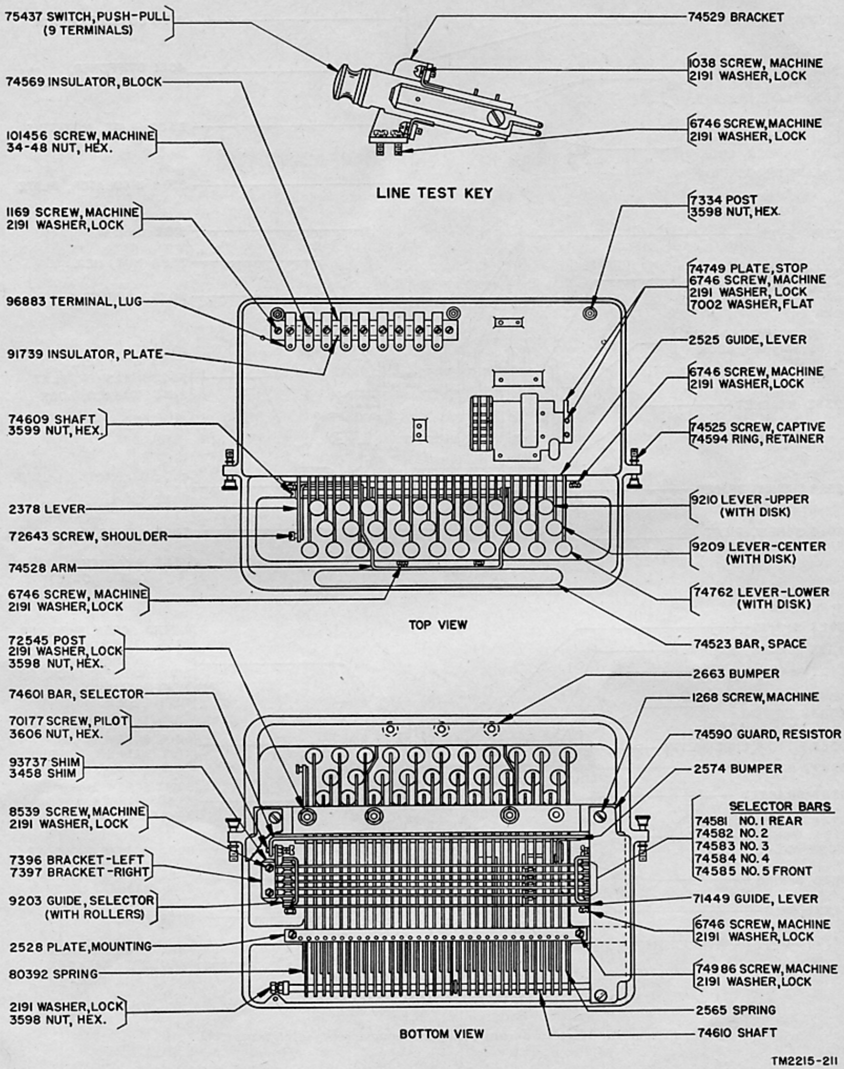


Figure 312. Keyboard and line test key, parts identification.

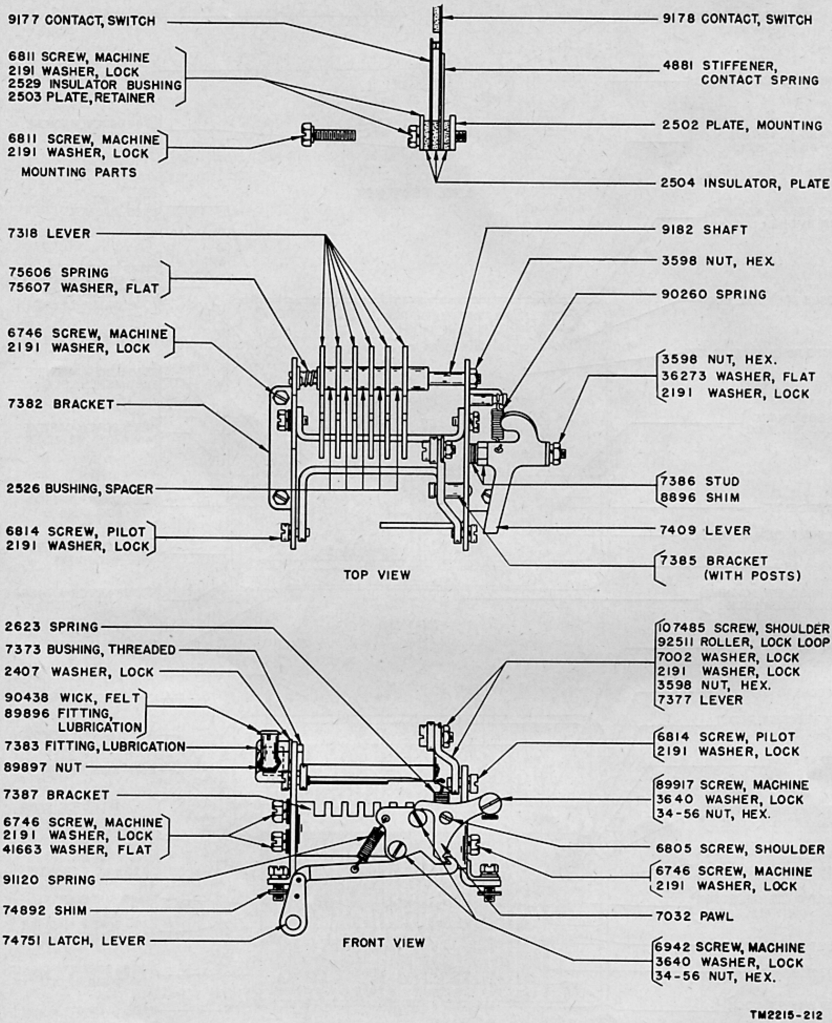
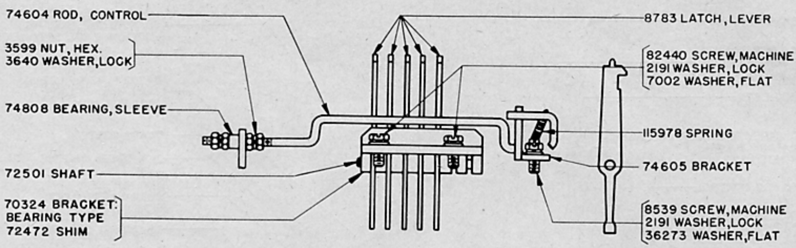
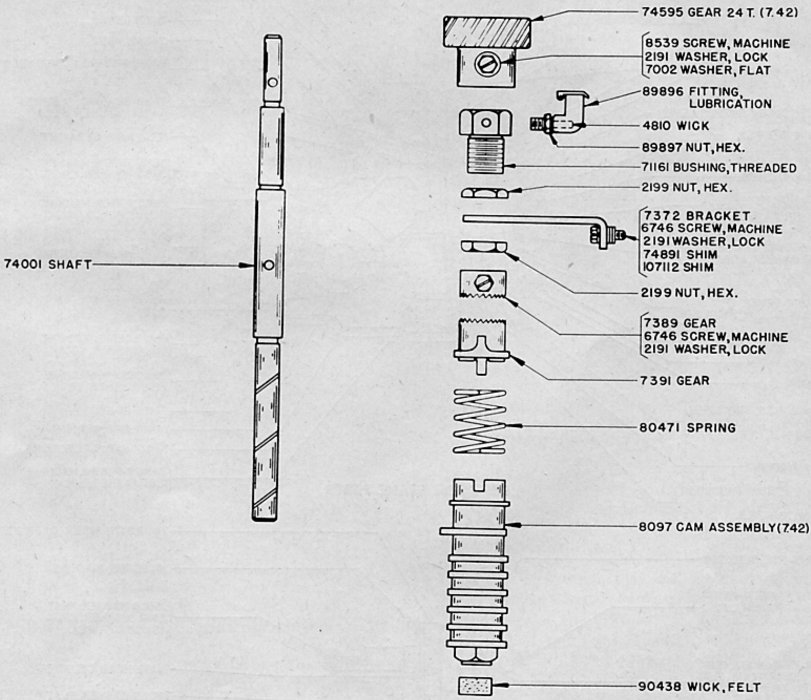


Figure 313. Keyboard-transmitting mechanism, parts identification.



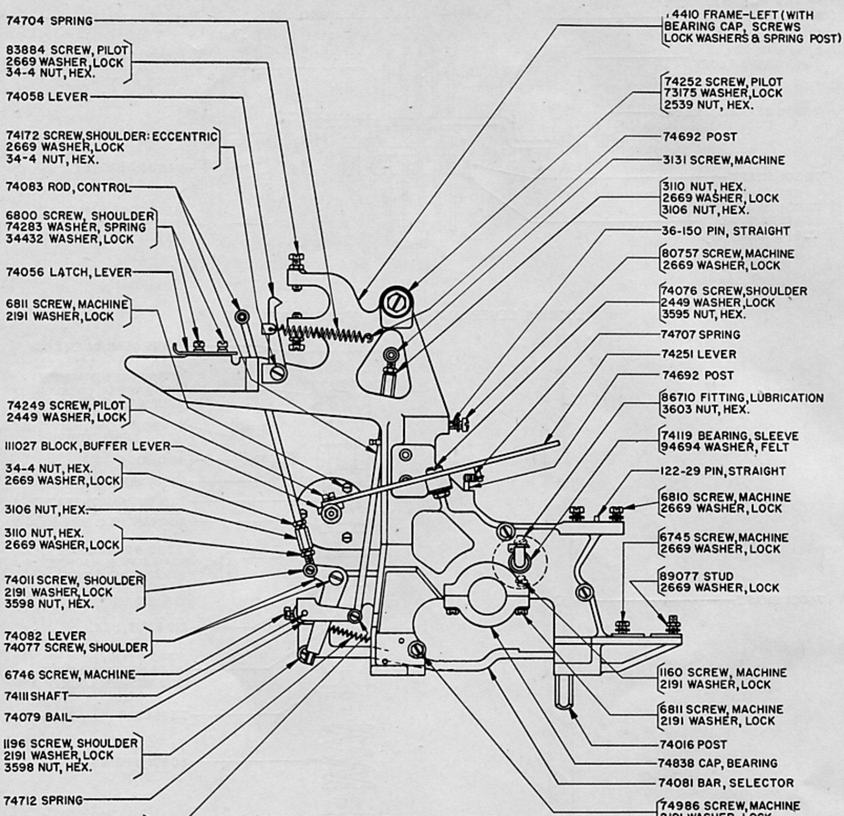
LOCKING LEVER AND REPEAT SPACE PARTS



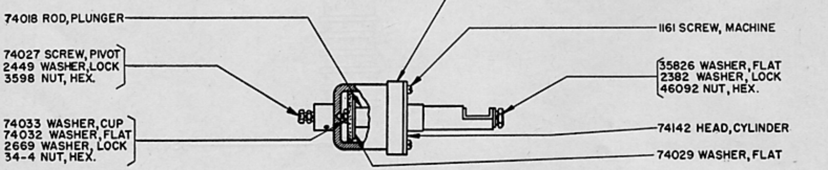
TRANSMITTING SHAFT PARTS

TM2215-213

Figure 314. Locking lever, repeat space and transmitting-shaft assembly, parts identification.



LEFT SIDE FRAME PARTS



DASHPOT PARTS

TM2215-214

Figure 315. Frame assembly (left side) and dash-pot assembly, parts identification.

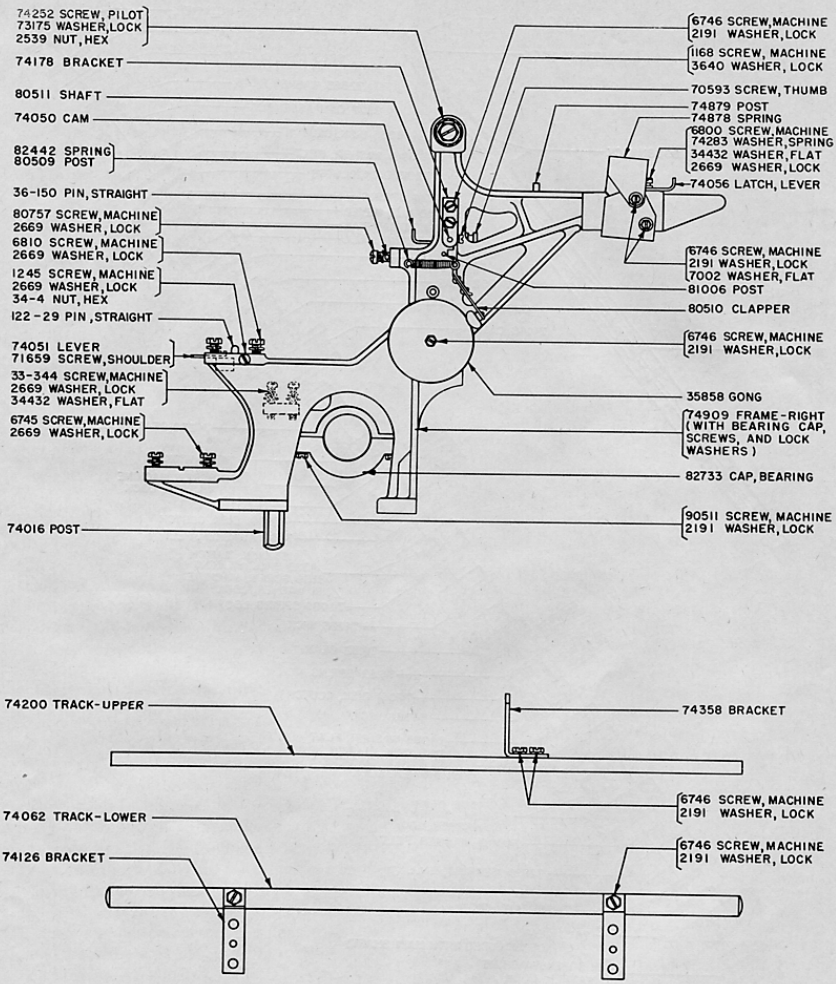


Figure 316. Frame assembly (right side) and carriage tracks, parts identification.

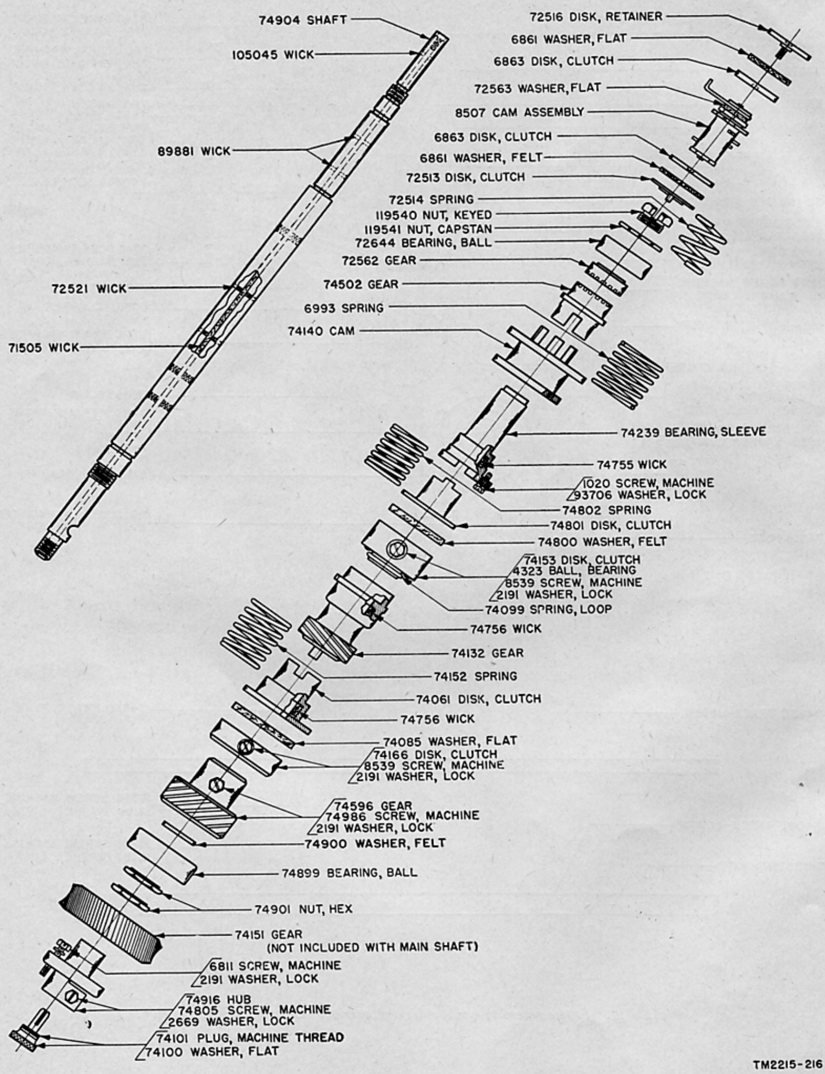


Figure 317. Main-shaft assembly, parts identification.

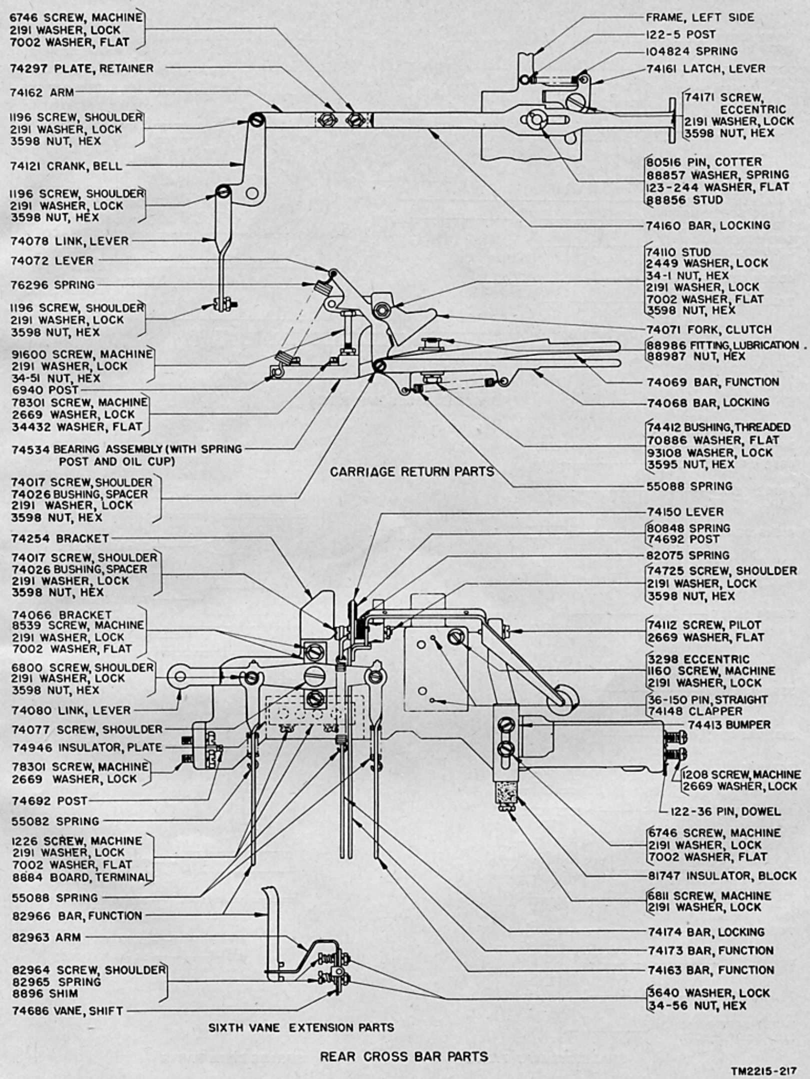


Figure 318. Carriage-return and rear crossbar, parts identification.

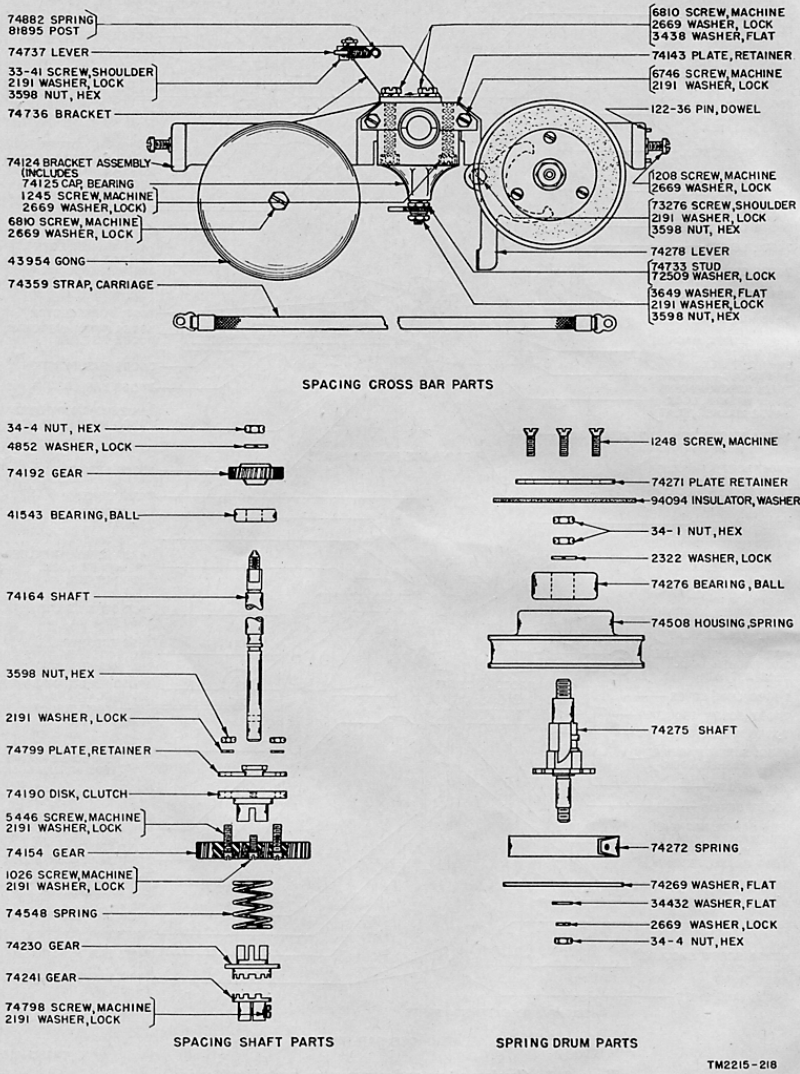
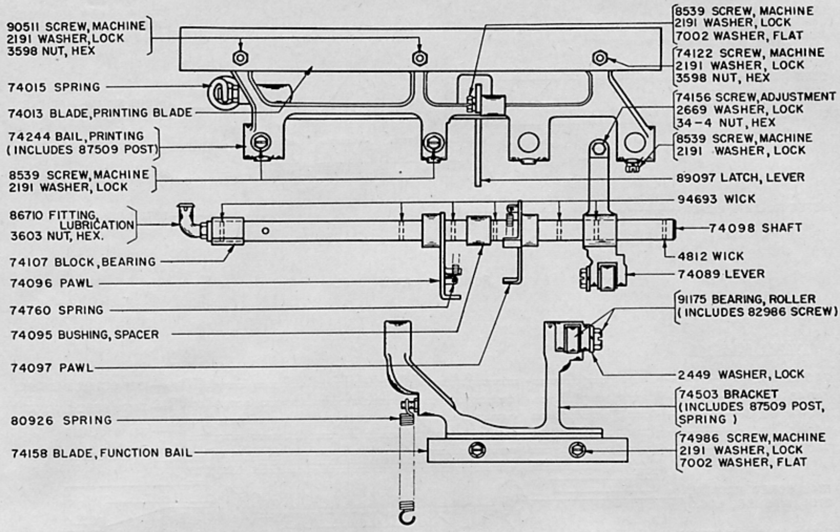
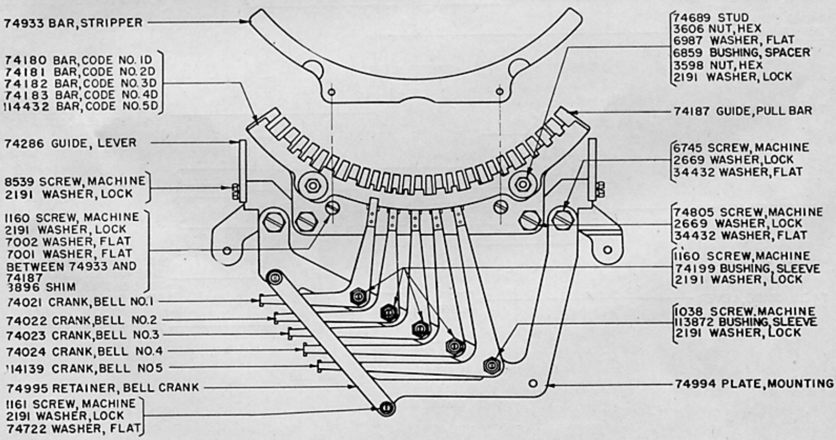


Figure 319. Spacing shaft, upper crossbar, and spring drum, parts identification.



PRINTING AND FUNCTION BAIL PARTS



CODE BAR AND BELL CRANK PARTS

TM2215-219

Figure 320. Printing bail, function bail, bell cranks, and code bars, parts identification.

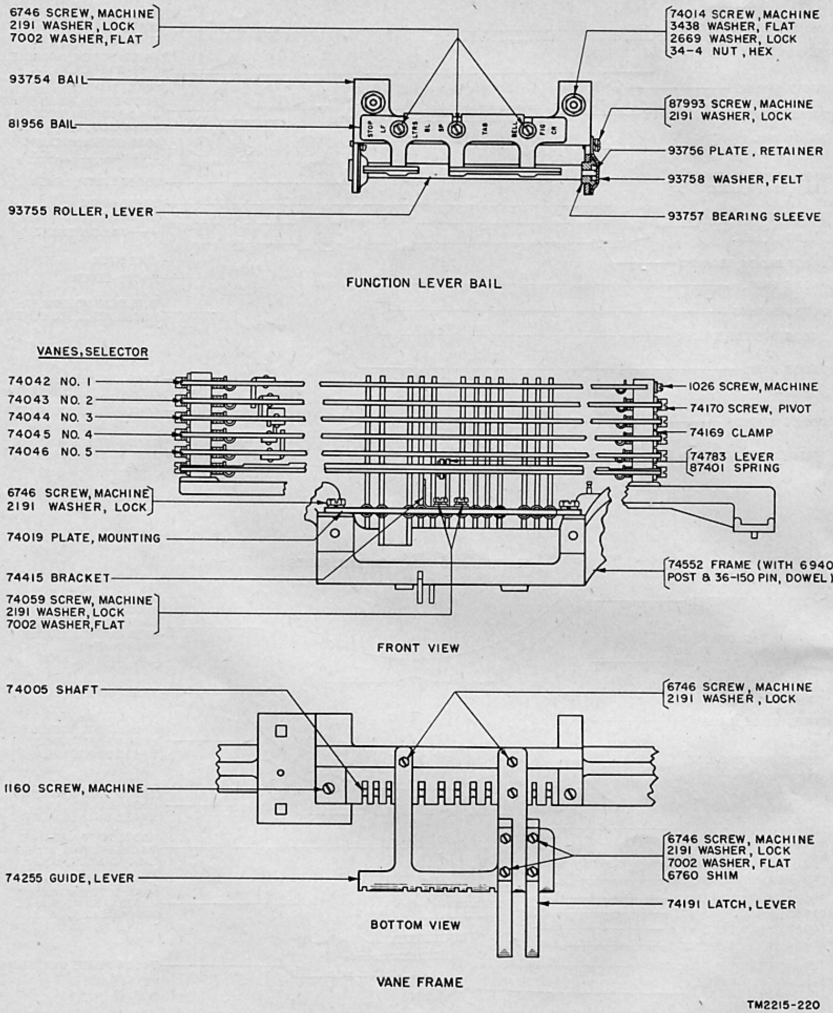


Figure 321. Vane frame and function-lever bail, parts identification.

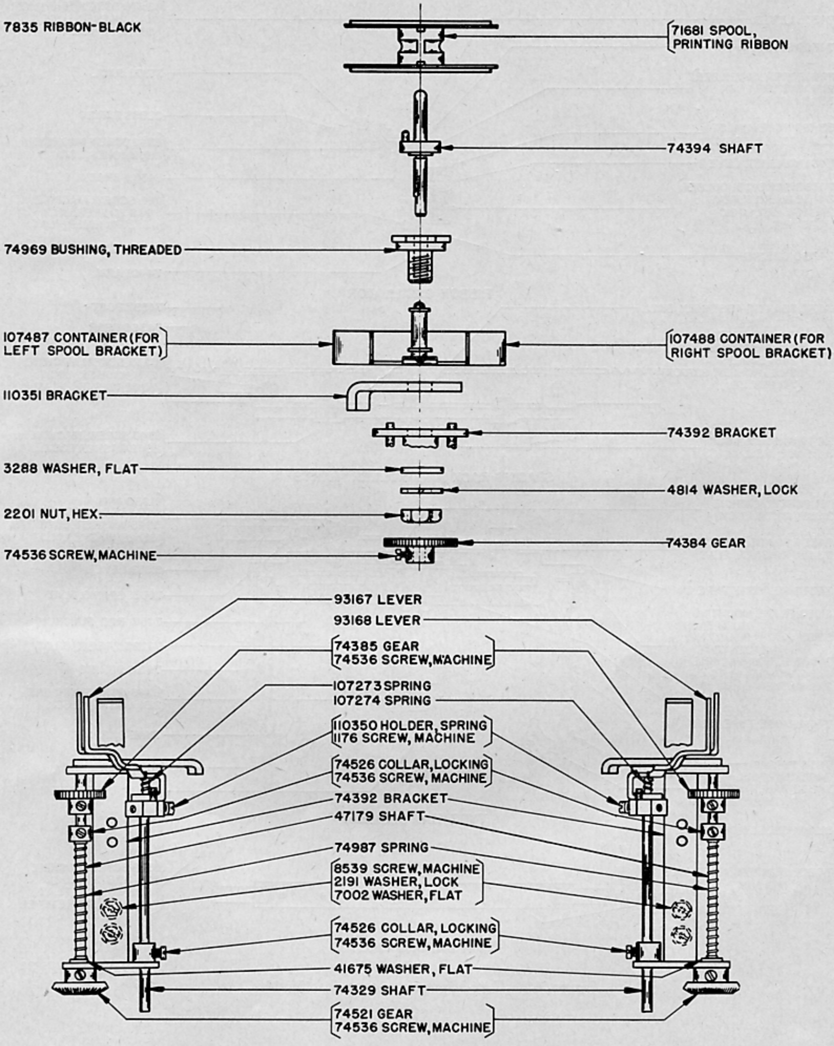


Figure 322. Ribbon-feed mechanism, parts identification.

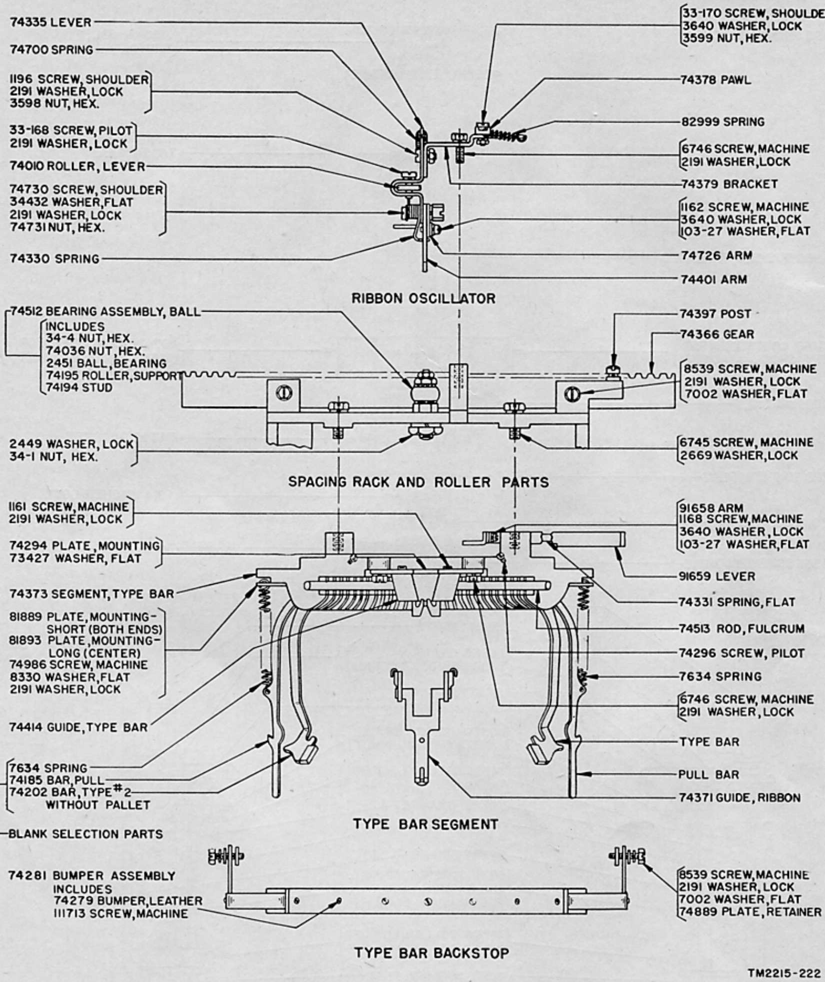


Figure 323. Type-bar carriage, parts identification.

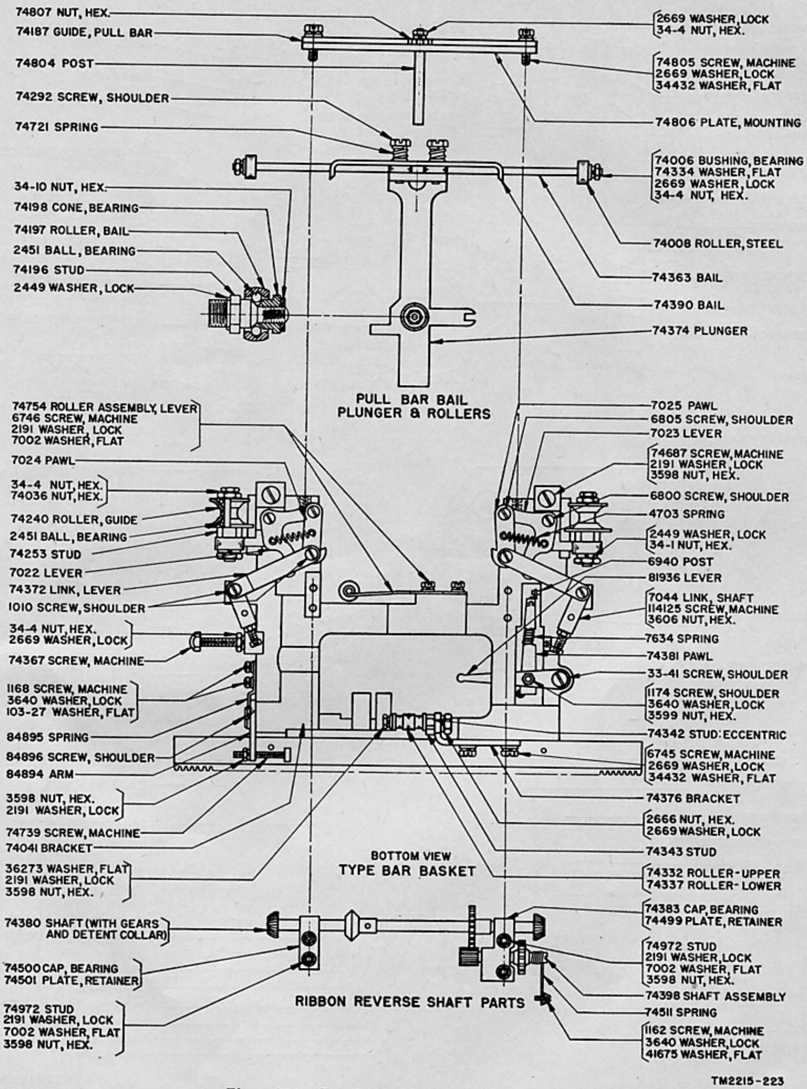
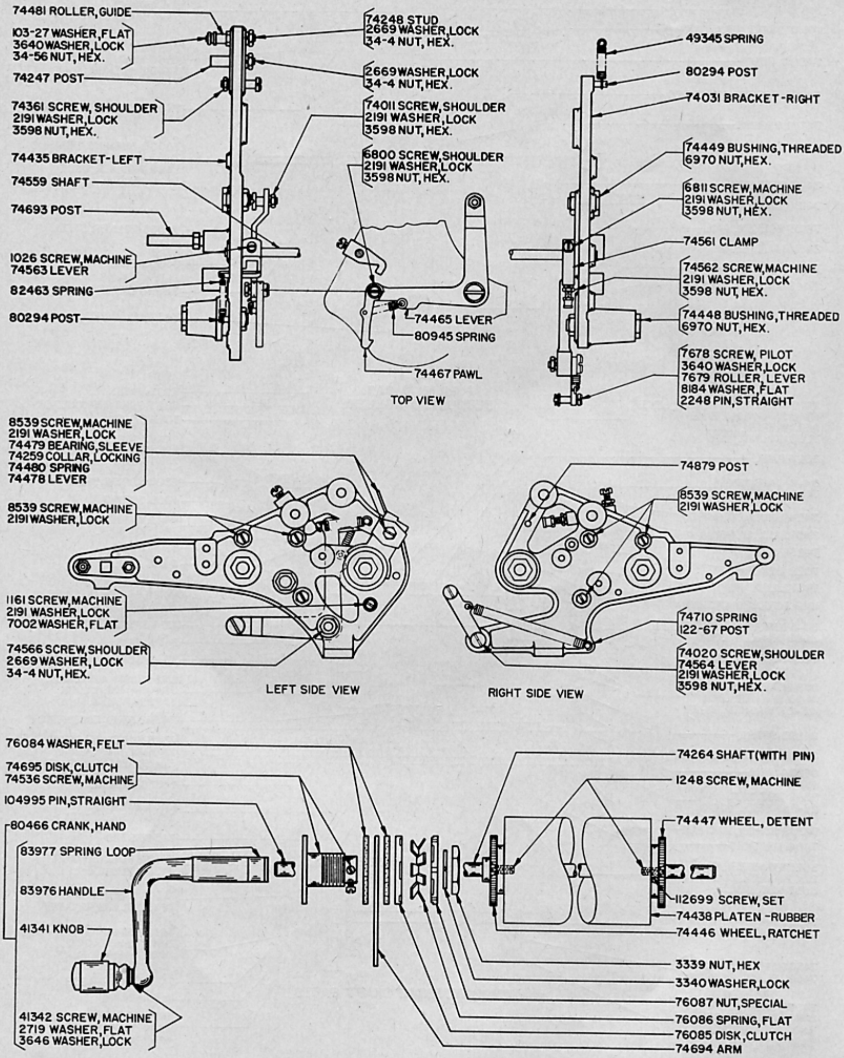


Figure 324. Type-bar carriage, parts identification.



TM2215-224

Figure 325. Platen assembly, parts identification.

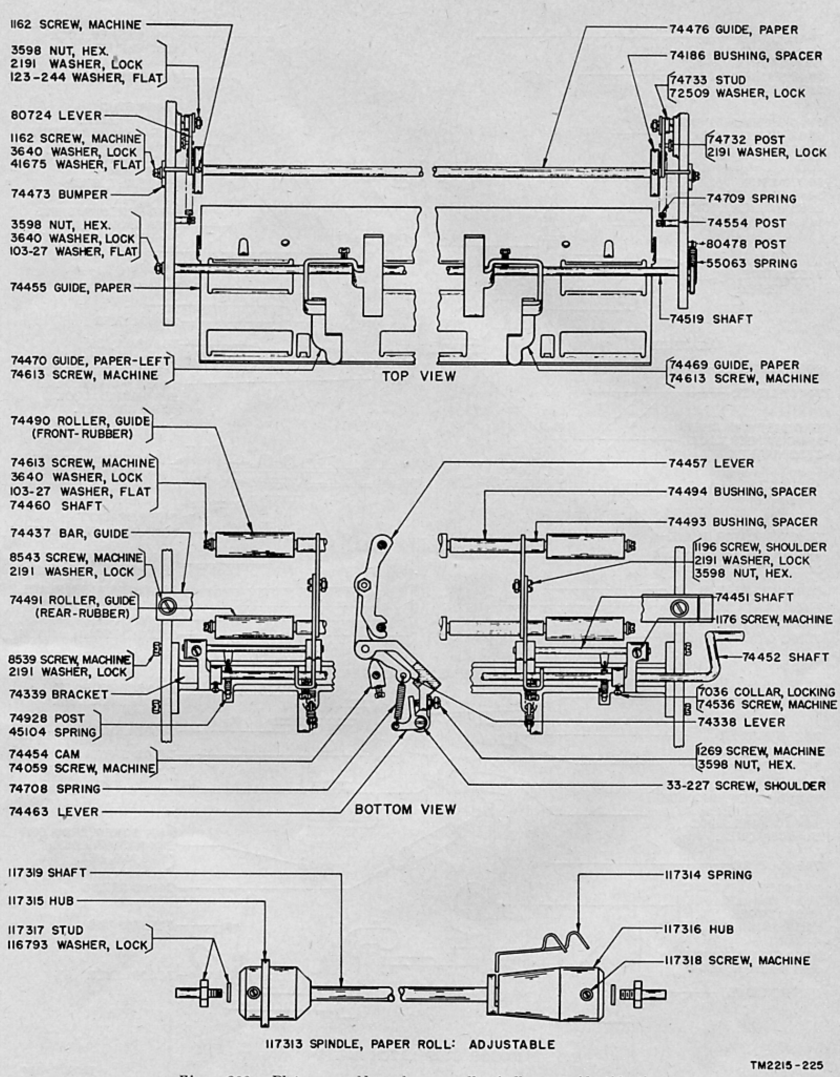
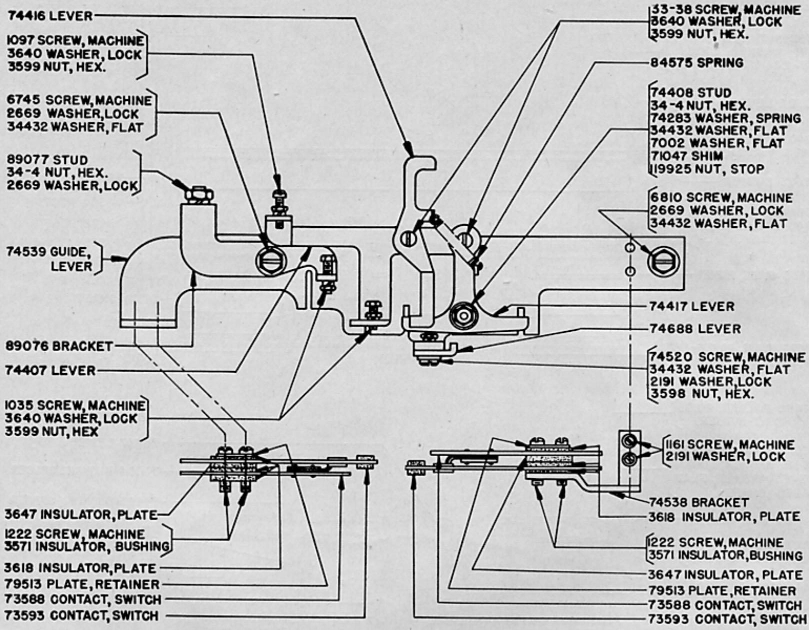
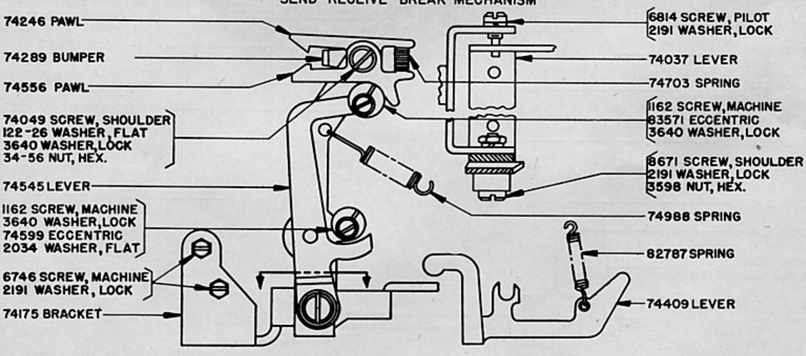


Figure 326. Platen assembly and paper roll spindle, parts identification.



SEND-RECEIVE BREAK MECHANISM



MOTOR STOP LATCH PARTS

TM2215-226

Figure 327. Motor-stop and send-receive break mechanism, parts identification.

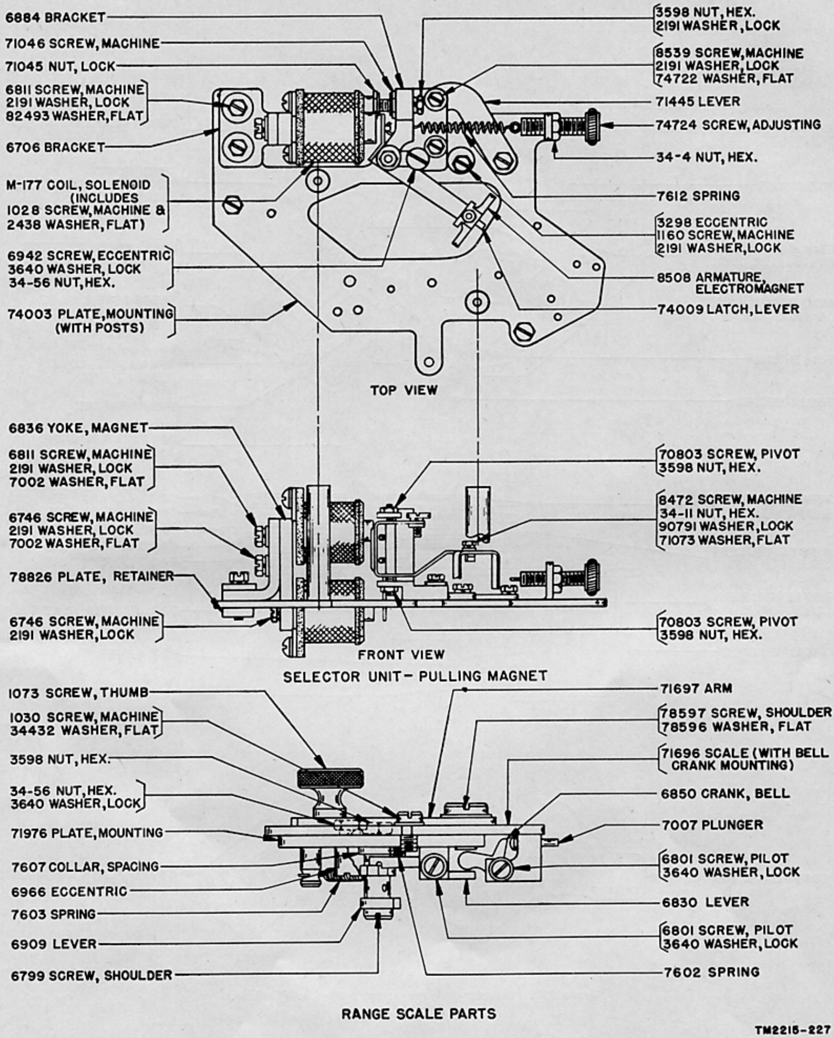
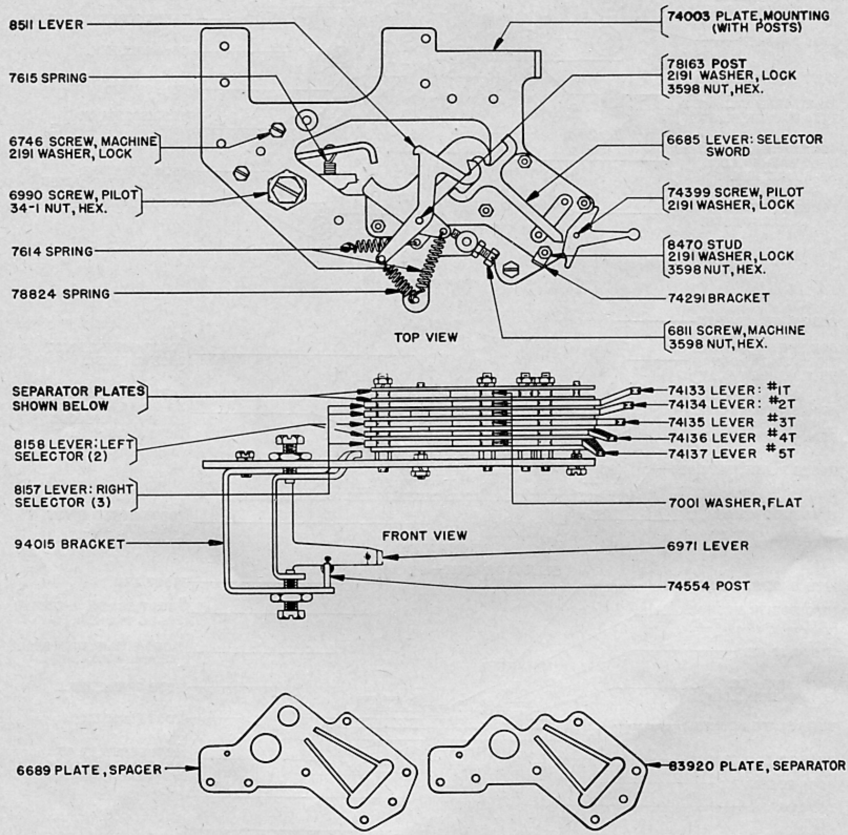
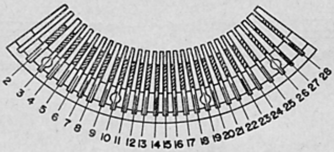


Figure 328. Selector-unit and rangefinder assembly, parts identification.



TM2215-228

Figure 329. Selector-unit assembly, parts identification.



NOTE

CHECK CAREFULLY THE POSITION OF PULL BARS IN THE SEGMENT AND THE ARRANGEMENT OF THE TYPE PALLETS ON THE TYPE BARS. IF THESE DIFFER IN ANY WAY WITH THE ARRANGEMENT SHOWN ON THIS PAGE, THE FOLLOWING PARTS SHOULD BE ORDERED BY NAME. FOR EXAMPLE ORDER:-
TYPE PALLET------------------------(A-)
TYPE BAR 17 (WITH PALLET)---------(A-)
SPRING CUSHION KEYTOP-----------(A-)

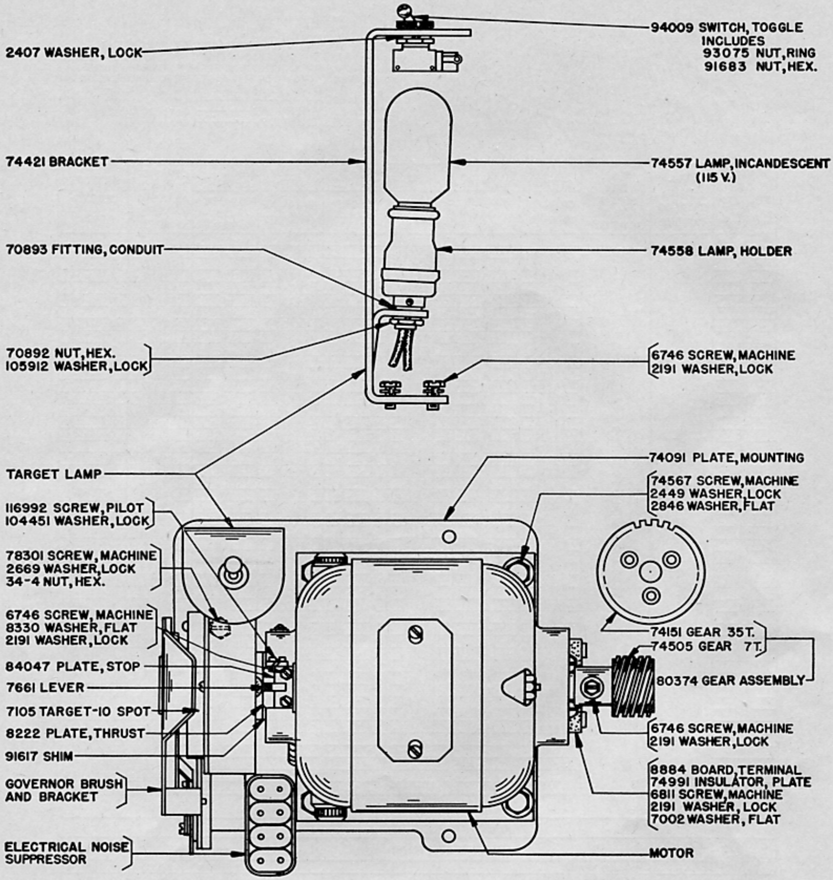
NUMBER OF POSITION IN SEGMENT	PULL BAR CATALOG NUMBER	PULL BAR SPRING CATALOG NUMBER	TYPE BARS (WITHOUT PALLETS) CATALOG NUMBER	TYPE BARS (WITHOUT PALLETS) NUMBER ON BAR	TYPE BARS PALLETS CATALOG NUMBER	TYPE BARS PALLETS DESCRIPTION	TYPE BARS (WITH PALLETS) CATALOG NUMBER	TYPE BARS (WITH PALLETS) NUMBER ON BAR	SPRING CUSHION KEYTOPS CATALOG NUMBER	KEYTOPS DESCRIPTION
1	74185 USED IN ALL POSITIONS	7634 USED IN ALL POSITIONS								
2			74202	2	84025	–	84734	2	89413	–
3			74203	3	74303	Z "	74643	3	78970	Z "
3			74203	3	82751	Z +	84735	3	89422	Z +
4			74204	4	74304	K (	74644	4	78956	K (
4			74204	4	82153	K ←	84736	4	89420	K ←
5			74205	5	74305	B ?	74645	5	78947	B ?
5			74205	5	82420	B ⊕	84737	5	89425	B ⊕
6			74206	6	96559	P Ø	102985	6	99564	P Ø
7			74207	7	74307	Y 6	74647	7	78969	Y 6
8			74208	8	74308	M .	74648	8	78958	M .
9			74209	9	74309	U 7	74649	9	78965	U 7
10			74210	10	74310	L)	74650	10	78957	L)
10			74210	10	82154	L ↖	84738	10	89421	L ↖
11			74211	11	74311	H £	74651	11	82607	H STOP
11			74211	11	82151	H ↓	84740	11	89418	H ↓
12			74212	12	74312	O 9	74652	12	78960	O 9
13			74213	13	74313	I 8	74653	13	78954	I 8
14			74214	14	74314	N ,	74654	14	78959	N ,
14			74214	14	84069	N ⦶	84742	14	89426	N ⦶
15			74215	15	74315	E 3	74655	15	78950	E 3
16			74216	16	74316	T 5	74656	16	78964	T 5
17			74217	17	74317	A –	74657	17	78946	A –
17			74217	17	82147	A ↑	84743	17	89414	A ↑
18			74218	18	74318	J '	74658	18	78955	J '
18			74218	18	82152	J ↙	84745	18	89419	J ↙
19			74219	19	74319	R 4	74659	19	78963	R 4
20			74220	20	74320	D $	74660	20	78949	D $
20			74220	20	82148	D ↗	84746	20	89415	D ↗
21			74221	21	74321	C :	74661	21	78948	C :
21			74221	21	82423	C O	84747	21	89423	C O
22			74222	22	74322	F !	74662	22	78951	F !
22			74222	22	82149	F →	84749	22	89416	F →
23			74223	23	74323	W 2	74663	23	78967	W 2
24			74224	24	74324	G &	74664	24	78952	G &
24			74224	24	82150	G ↘	84750	24	89417	G ↘
25			74225	25	74325	V ;	74665	25	78966	V ;
25			74225	25	82421	V ⦶	84752	25	89424	V ⦶
26			74226	26	74326	Q 1	74666	26	78962	Q 1
27			74227	27	74327	X /	74667	27	78968	X /
28			74228	28	74328	S '	74668	28	78980	S BELL
									78972	FIGS.
									78973	LTRS.
									78976	CAR. RET.
									78978	LINE FEED
									78971	BLANK

FUNCTION LEVERS					
CATALOG NUMBER	POSITION USED	FUNCTION PERFORMED	SPRING	CODE SELECTION	STAMPING
74040	1	LOCKS VANES	74962	NOTE 1	1
74131	2	CARRIAGE RETURN	74961	- - - 4 -	2
84927	2	CARRIAGE RETURN IN "LETTERS" POSITION ONLY	74961	- - - 4 -	S2
74128	3	SHIFT TO "FIGURES" POSITION	74962	1 2 - 4 5	3
74138	4	BELL ON "FIGURES" "S"	74961	1 - 3 - -	4
74109	5	RESETS SEND-RECEIVE BREAK MECHANISM	86873	NOTE 2	5A
74932	7	SUPPRESSES PRINTING & SPACING ON "BLANK"	87402	- - - - -	7A
84060	7	SUPPRESSES PRINTING & SPACING ON "BLANK", IN "LETTERS" POSITION ONLY	4708	- - - - -	7B
74130	9	SHIFT TO "LETTERS" POSITION ON SPACE	74962	- - 3 - -	9
74039	10	OPERATES SEND-RECEIVE BREAK MECHANISM ON "BLANK" SIGNAL	74705	- - - - -	10
74129	11	SHIFT TO "LETTERS" POSITION	74962	1 2 3 4 5	11
74127	12	LINE FEED	74962	- 2 - - -	12
84928	12	LINE FEED IN "LETTERS" POSITION ONLY	74962	- 2 - - -	12A
82271	13	MOTOR STOP ON "FIGURES" "H"	82788	- - 3 - 5	13D

NOTE 1-OPERATES ON ALL COMBINATIONS   NOTE 2-OPERATES ON ANY PRINTED CHARACTER.

TM2215-229

Figure 330. Pull bars, type bars, keytops, and function levers, parts identification.



MU-27 MOTOR UNIT

TM2215-230

Figure 331. Motor unit, parts identification.

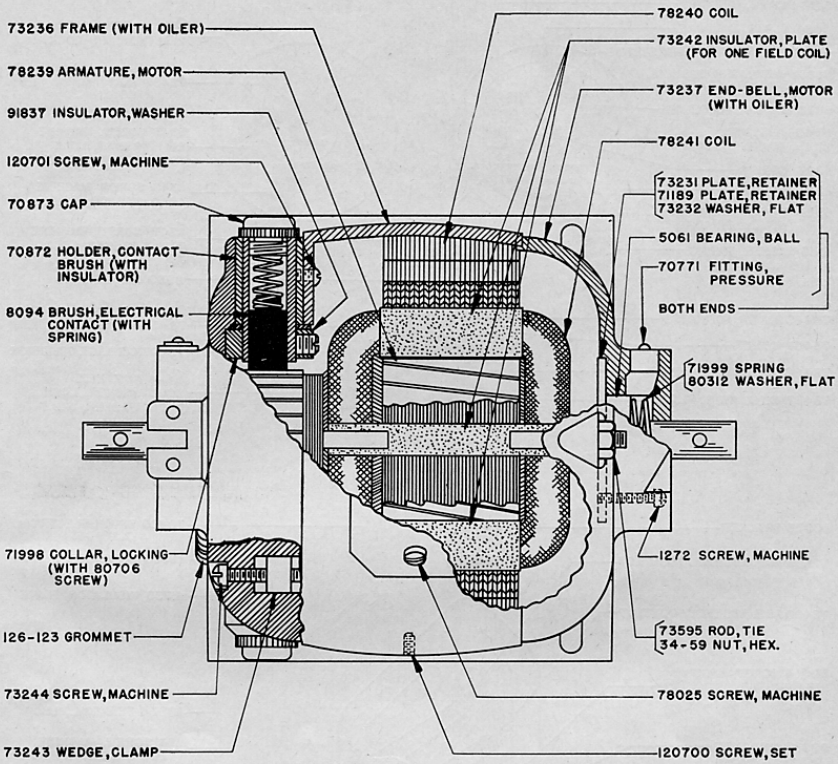


Figure 332. Motor, parts identification.

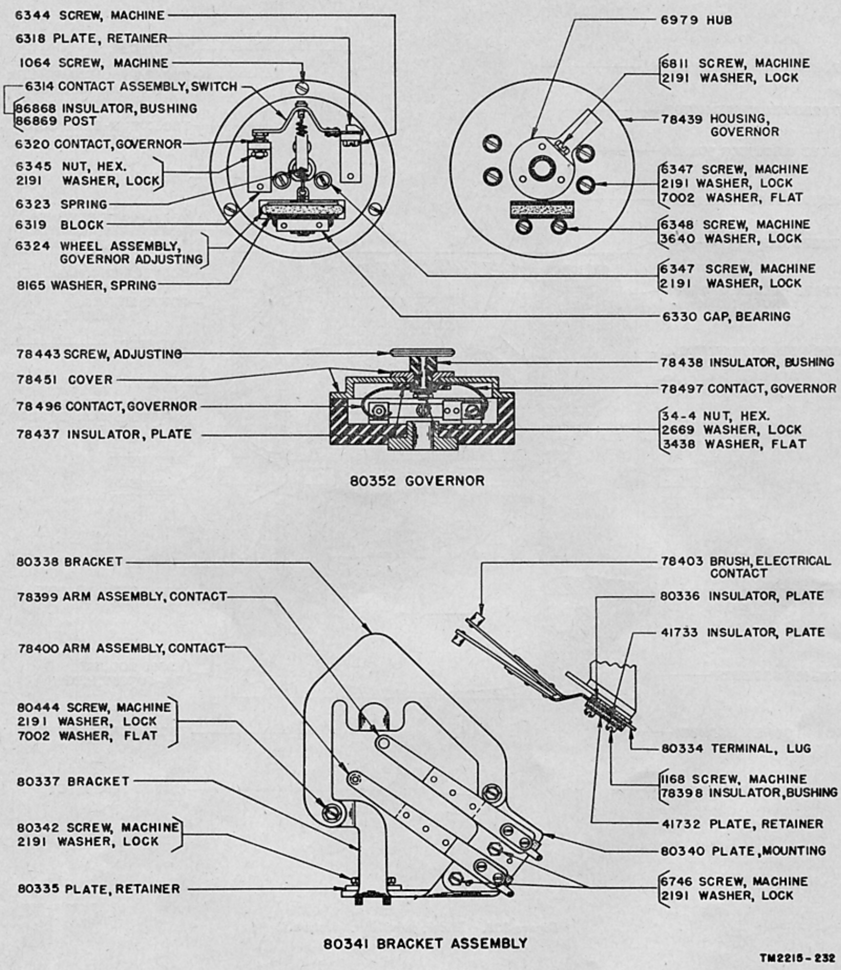


Figure 333. Motor governor, parts identification.

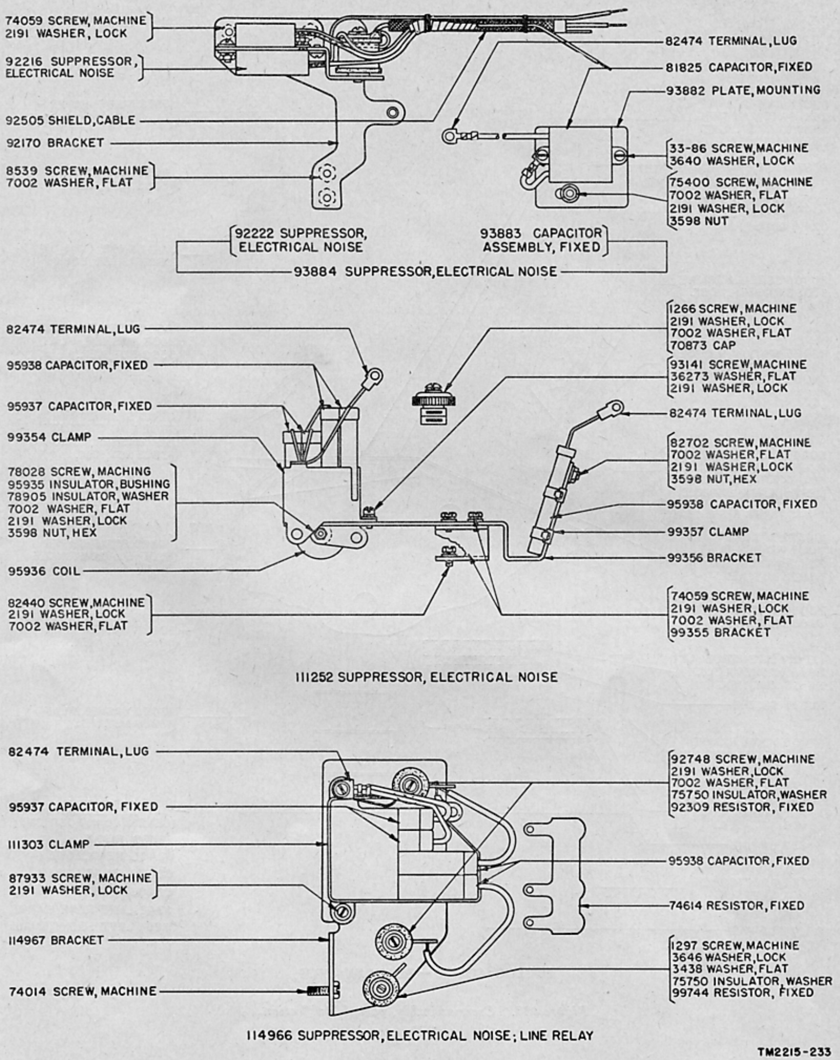


Figure 334. Electrical noise suppressor assembly, parts identification.

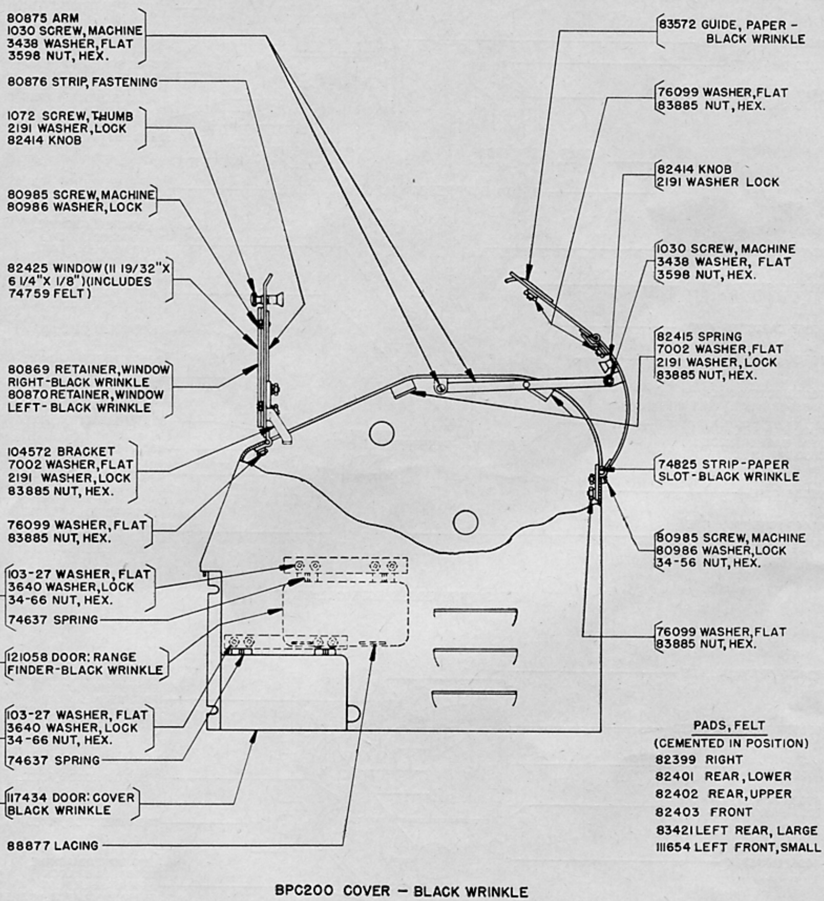
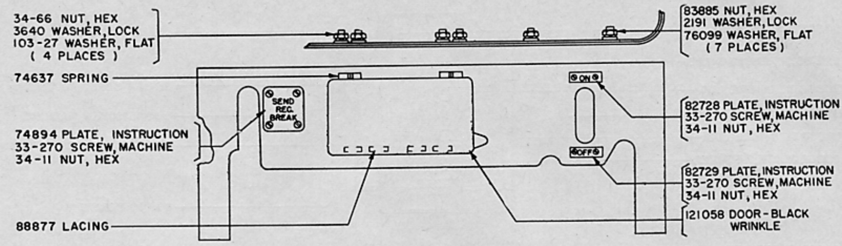
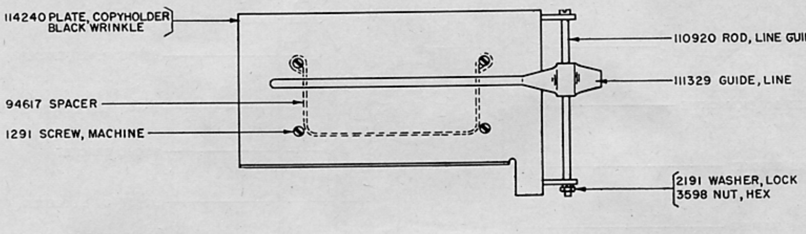


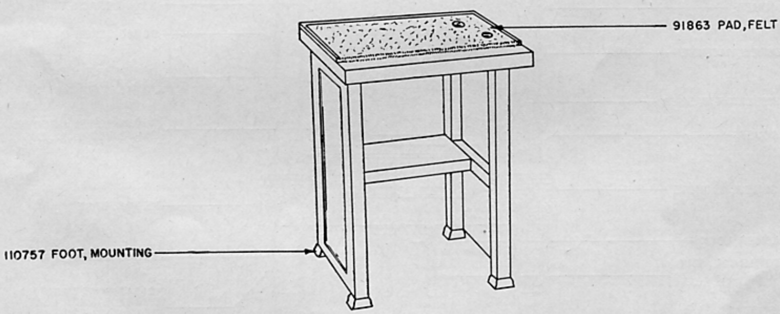
Figure 335. Cover assembly, parts identification.



115706 PLATE, COVER FRONT – BLACK WRINKLE



115700 COPYHOLDER ASSEMBLY 6" – BLACK WRINKLE



XRT200 TABLE – BLACK WRINKLE

TM2215-235

Figure 336. Cover front plate, copyholder, and teletypewriter table, parts identification.

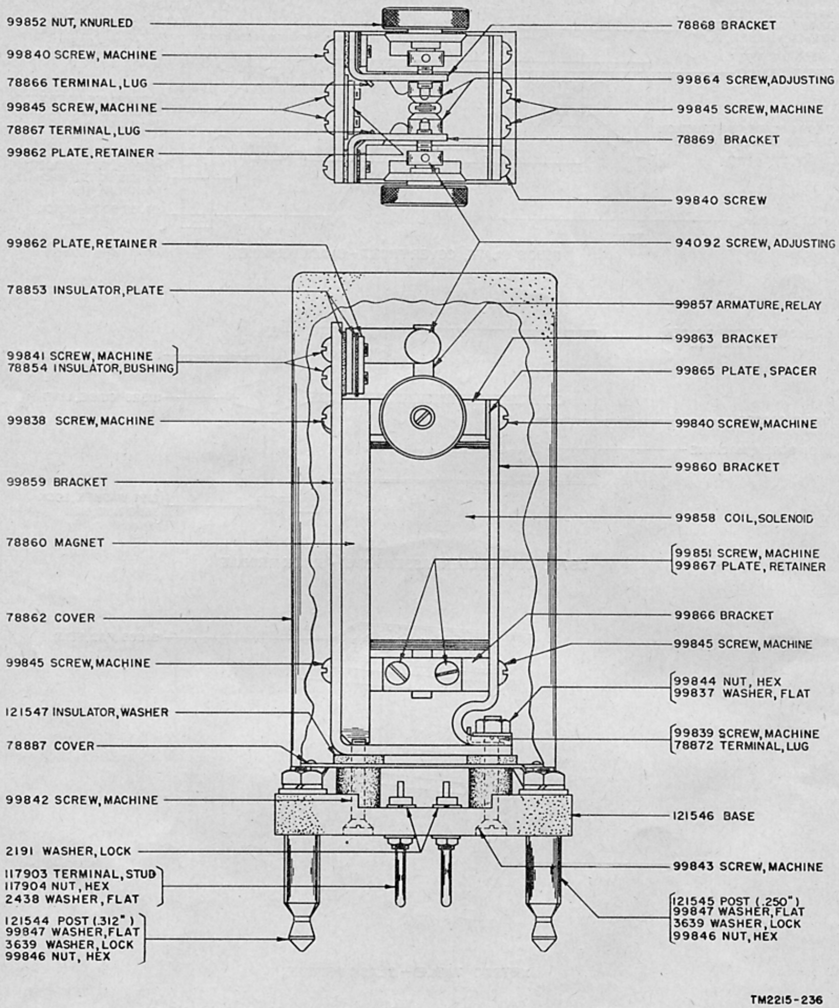


Figure 337. Line relay, parts identification.

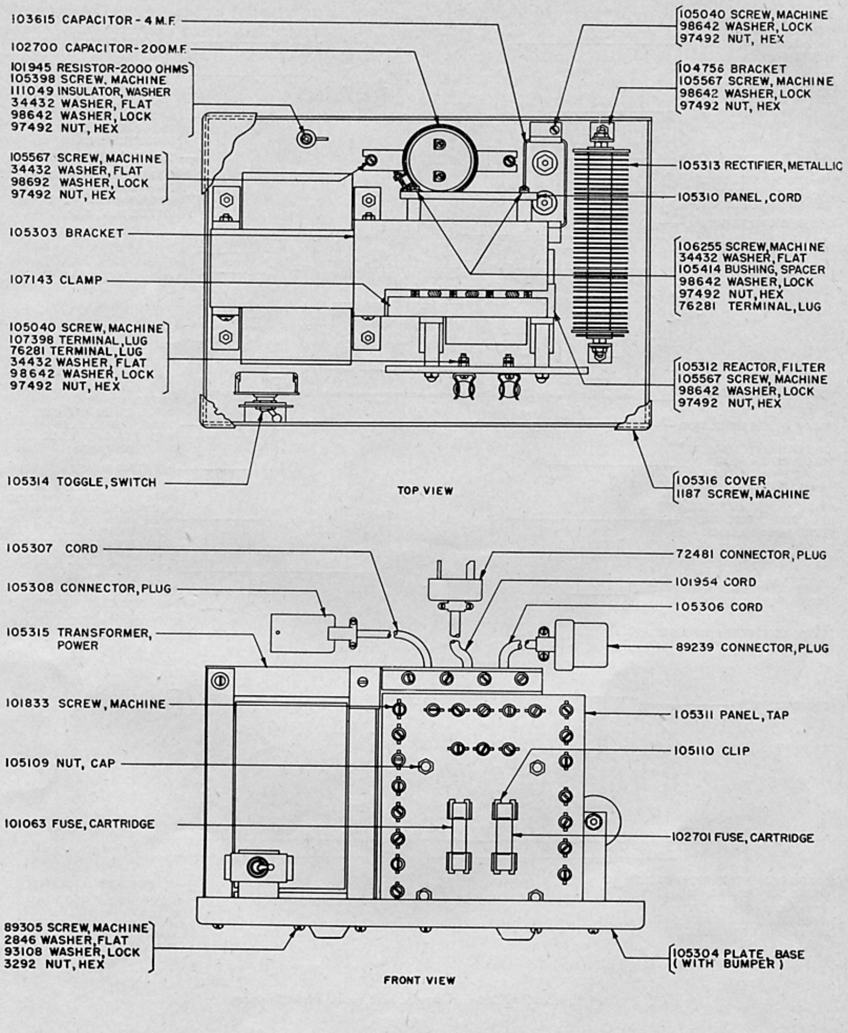


Figure 338. Power supply unit, parts identification.

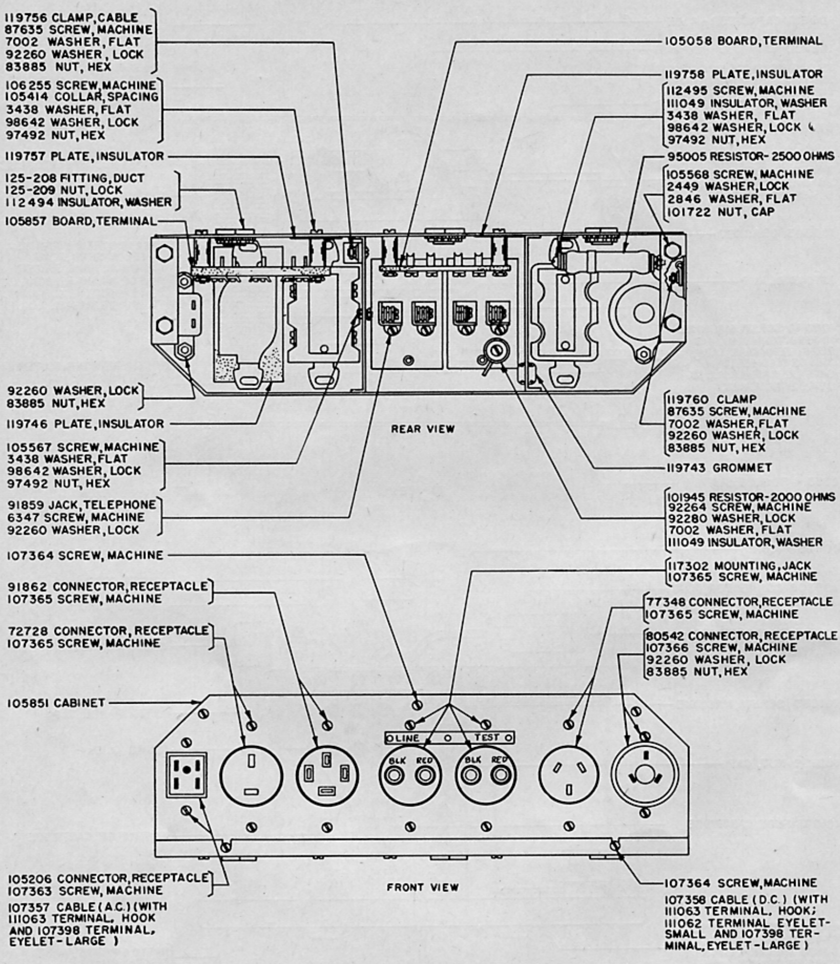


Figure 339. Electrical service unit, parts identification.

APPENDIX III

INTEROPERATION OF BRITISH AND AMERICAN TELETYPEWRITERS

1. Introduction

a. GENERAL. Joint military operations involving British and American forces in the same general area may require the interconnection of their teletypewriter systems. (The British use the term teleprinter rather than teletypewriter.)

b. FEATURES. The principal features of British teleprinter equipment which affect the operation of American teletypewriters are described in paragraph 2 of this appendix. The changes which must be made in the adjustment for operation of Teletypewriter TT–5/FG to permit interconnection with British teleprinters are discussed in paragraph 3. Teletypewriter TT–6/FG is normally used in systems which are not directly interconnected with British teleprinters.

2. Features of British Equipment Compared With Teletypewriter Set TT–5/FG

a. SELECTING CODE. The British teleprinter uses the same five-unit start-stop selecting code as the American teletypewriters.

b. CHARACTER DIFFERENCES. There are few differences in the keyboards of the two teletypewriters. In the lower case, there are no differences and the keys have the same relative position on the keyboards. In the upper case, there are differences in D, F, G, H, J, S, V, and Z operations as listed in the following table:

Keyboards			
Lower case		Upper case	
American	*British*	*American*	*British*
D	D	$	Who are you
F	F	!	%
G	G	&	@
H	H	STOP	(£) (pound symbol)
J	J	'	Bell
S	S	Bell	'
V	V	;	=
Z	Z	"	—

c. PRINTING. American teletypewriters select and print each character in the same operating cycle. The British teleprinters, however, do not print a character until the succeeding one is being received, with the result that a character is always stored in the teleprinter. The length of the line typed by the British teleprinter is 70 characters which cannot be changed; therefore, the change must be made in the American teletypewriter.

d. TRANSMITTING. The teleprinter ordinarily transmits polar impulses instead of the neutral impulses transmitted by Teletypewriter TT–5/FG. Teleprinters are equipped with an automatic send-receive mechanism. When any keyboard key is depressed the circuit is put in the transmitting position, and as soon as the character has been sent the circuit returns automatically to receiving position. Therefore, the machine is always in the receiving position except when a key is depressed.

e. ANSWER-BACK FEATURE. Some teleprinters are equipped with a special answer-back feature. When the upper case D is operated, the teleprinter receiving it automatically sends back its code station call.

f. SIGNAL BELL. A signal bell is not standard equipment on the British teleprinter. However, an attachment can be added to the teleprinter so that when upper case J is operated a contact is closed to operate an external signal bell.

g. MOTOR CONTROL. The British teleprinters are not designed for remote electrical motor control. These teleprinters have a timing device which, when the line remains marking for a period of approximately 90 seconds, automatically stops the motor. To restart the motor it is necessary to open the line.

h. SPEED DIFFERENCES.

(1) *Normal American speed.* American equipment normally operates at 368.1 opm. This is equivalent to approximately 61 wpm. The length of the signaling code for each character is 7.42

units in which the start and five selecting impulses are each 1 unit in length, while the stop impulse is 1.42 units in length.

(2) *Normal British speed.* The teleprinter motor is a 24-volt d-c governed shunt motor designed to operate at 3,000 rpm and does not have provision for easily adjusting the speed to 2,740 rpm. corresponding to the normal American speed of operation. British teleprinters normally operate at 400 opm or approximately 67 wpm. The length of the signaling code for each character is 7.50 units in which the start and five selecting impulses are each 1 unit in length, while the stop impulse is 1.50 units in length.

(3) *Summary.* Since the British speed is 400 opm, it is necessary to adjust the American equipment to operate at 404 opm, in order to correct for the differences in length of the character signaling codes. Thus, if the British equipment transmits 7.5 unit characters at the rate of 400 opm, it will be necessary for the American equipment to transmit 7.42 unit characters at the rate of 404 opm.

3. Changes Necessary in Teletypewriter TT–5/FG

Note. The information in this paragraph contains only the necessary mechanical changes needed to modify the American teletypewriter for interoperation with British teleprinters. See the related teletypewriter set or system manual for information on installation and operation of American and British equipment connected in the same teletypewriter system. No internal electrical changes are involved.

a. Speed. It is necessary that all machines in a network be adjusted to an equivalent number of opm. The American machine must be speeded up to 404 opm by increasing the motor speed. A speed indicator vibrating at 96.19 vps (vibrations per second) is used for this adjustment. The procedure for adjusting to the new speed is the same as that used with the regular tuning fork. See paragraph 22*b* for instructions on adjusting the motor speed.

Note. When the speed of American equipment (368 opm) is increased to operate with British Creed equipment (404 opm), it may be desirable to increase the tension of the armature spring on the teletypewriter receiving mechanism by approximately ½ ounce, if such increased tension results in improved operating margins.

b. Length of Typed Line. It is also necessary to change the number of characters per line on the American machine to correspond to the British line of 70 characters. This is done by resetting the right margin adjusting screw. A corresponding adjustment must be made on the end-of-line indicating bell, so that it will ring on the 64th character.

c. Unshift-on-Space Feature. The unshift-on-space feature (par. 103) of the American teletypewriter must be made inoperative as the British machines are not equipped with such a feature. This concludes all of the mechanical changes necessary for interoperation.

SIGNAL CODE					KEYBOARDS			
					LOWER CASE		UPPER CASE	
1	2	3	4	5	AMERICAN	BRITISH	AMERICAN	BRITISH
■	■				A	A	–	–
■			■	■	B	B	?	?
	■	■	■		C	C	:	:
■			■		D	D	$	WHO ARE YOU (1)
■					E	E	3	3
■		■	■		F	F	!	%
	■		■	■	G	G	&	@
		■		■	H	H	STOP	£
	■	■			I	I	8	8
■	■		■		J	J	'	BELL (2)
■	■	■	■		K	K	(	(
	■			■	L	L	)	)
		■	■	■	M	M	.	.
		■	■		N	N	,	,
			■	■	O	O	9	9
	■	■		■	P	P	Ø	0
■	■	■		■	Q	Q	1	1
	■		■		R	R	4	4
■		■			S	S	BELL	'
				■	T	T	5	5
■	■	■			U	U	7	7
	■	■	■	■	V	V	;	=
■	■			■	W	W	2	2
■		■	■	■	X	X	/	/
■		■		■	Y	Y	6	6
■				■	Z	Z	"	+
	■				LINE FEED	LINE FEED	LINE FEED	LINE FEED
			■		CAR. RET.	CAR. RET.	CAR. RET.	CAR. RET.
■	■		■	■	FIGS.	FIGS.	FIGS.	FIGS.
■	■	■	■	■	LTRS.	LTRS.	LTRS.	LTRS.
		■			SPACE	SPACE	SPACE	SPACE

(1) NOT USED ON BRITISH ARMY FIELD MACHINES. USED ON D.T.N. IN GREAT BRITAIN.
(2) NOT USED BY BRITISH ARMY.

TL- 50174

Figure 340. Differences between American and British keyboards.

APPENDIX IV

GLOSSARY

The following glossary contains explanations of the technical terms used in this manual:

Battery—The term "battery" is normally used when referring to a group of dry cells or storage cells. In teletypewriter communication, it is common usage to refer to any d-c source used in the production of teletypewriter signals as battery.

Bias—The effect, on the length of telegraph signals, produced by the electrical characteristics of the line and equipment. If the received signal is longer than the signal sent, the distortion is called marking bias; if the received signal is shorter than the signal sent, the distortion is called spacing bias.

Capacitor—A device for inserting the property of capacitance into a circuit; two or more conductors separated by a dielectric.

Function—The term "function" refers to an operation performed by a teletypewriter such as carriage return, line feed, figures (shift), letters (shift), motor stop, bell, etc., that normally is not associated with a printed character.

Fuse—A wire, bar, or strip of fusible metal inserted as a safety device in an electric circuit. When the current increases beyond the rated value of the fuse, the metal melts and thus the circuit is broken.

Fusetron—A fuse equipped with an overload feature. A fusetron will take a starting load up to 50 percent in excess of the rated value for a short period before blowing. The fusetron has a base connection similar to that of a fuse.

Governor—An automatic attachment to a motor for controlling the speed of rotation.

Ground—The contact of a conductor with the earth; also the earth when used as a return conductor.

Jack—A receptacle which, in combination with a plug, provides a device by means of which connections readily can be made in electrical circuits.

Key—A hand-operated device for the rapid opening and closing of a circuit or circuits.

Mark and space impulses—In neutral operation the term mark impulse refers to the closed circuit signal and the term space impulse refers to the open circuit signal. In other than neutral operation, the term mark impulse is applied to the circuit condition which produces the same result in the terminal equipment that a mark impulse produces in neutral operation. Similarly, the term space impulse is applied to the circuit condition which produces the same result in the terminal equipment that a space impulse produces in neutral operation.

Neutral operation—The term neutral operation refers to the system whereby marking signals are formed by current impulses of one polarity, either positive or negative, and spacing signals are formed by reducing the current to zero or nearly zero.

Operations per minute—The term operations per minute refers to the number of functions performed or characters printed per minute. The equipment goes through one complete cycle of operation for each function performed or character printed.

Polar operation—The term polar operation refers to the system whereby marking signals are formed by current impulses of one polarity and spacing signals by current impulses of equal magnitude but opposite polarity.

Rectifier—A device for changing ac to dc.

Space impulse—See "mark impulse."

INDEX

TM 11-2234, TM 11-2215, TM 11-2216, TM 11-2222, TM 11-352, TM 11-358

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER
TELETYPEWRITERS TT-5/FG AND TT-6/FG

TM 11-2215
TO 31W4-2FG-101
CHANGES No. 1

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
WASHINGTON 25, D. C., *27 June 1955*

TM 11-2215/TO 31W4-2FG-101, 14 June 1951, is changed as follows:

4. COMPONENT PARTS AND PACKING DATA

a. Table of Components. The principal components * * * the same outwardly.

Quantity per set	Type of teletypewriter and Signal Corps stock No.		Component
	TT-5/FG (4T2.18A)	TT-6/FG (4T2,16A-1)	
*	* *	*	*
1	4TBK22JX	4TBK22KQ/G	Keyboard (with filters).
1	4TC105	4TC105	Cover
*	* *	*	*

Note. These lists are * * * for packing information.

* * * * *

88.1 End-of-Line Printing and Spacing Cutout Mechanism
(Added)

Note. This information applies only to those printers that are equipped with the end-of-line printing and spacing cutout mechanism.

a. Description and Purpose. The end-of-line printing and spacing cutout mechanism prevents printing and spacing at the end of a line. When a type-bar carriage approaches the end of the line, this mechanism engages the rear blade of the printing bail (fig. 107.1), blocking further printing. This action also stops spacing by causing the lower arm of the spacing stop lever to move into the path of a projection of the spacing stop sleeve on the main shaft.

b. Operation. The printing and spacing cutout action results from the sequence of operations that follow:

(1) As the carriage approaches the right margin, the right margin adjusting screw strikes the upper end of the spacing stop lever (fig. 107.1). The spacing stop lever is forced to turn in a clockwise direction.

(2) As the spacing stop lever moves clockwise, its horizontal arm moves upward. This arm extends under the printing cutout latch. The upward movement of the stop lever arm lifts the forward end of the printing cutout latch; this action latches the rear printing bail blade. When latched, the printing bail is prevented from moving fully forward and printing is prevented.

(3) While the printing bail is being latched, the lower end of the spacing stop lever is moved into the path of a projection on the spacing stop sleeve. The spacing stop sleeve, blocked in this manner, prevents further spacing.

98.1 Automatic Carriage-Return and Line-Feed Mechanism
(Added)

a. Description and Purpose. The automatic carriage-return and line-feed mechanism provides for automatic carriage return and line feed whenever the type-bar carriage reaches a predetermined position at the end of a line of printing. This is an emergency feature in case the carriage-return signal has not been received.

b. Operation. When the type-bar carriage reaches the end of a line, a yield lever on the lower end of the bell crank retainer assembly (fig. 117.1) engages a screw on the trigger of

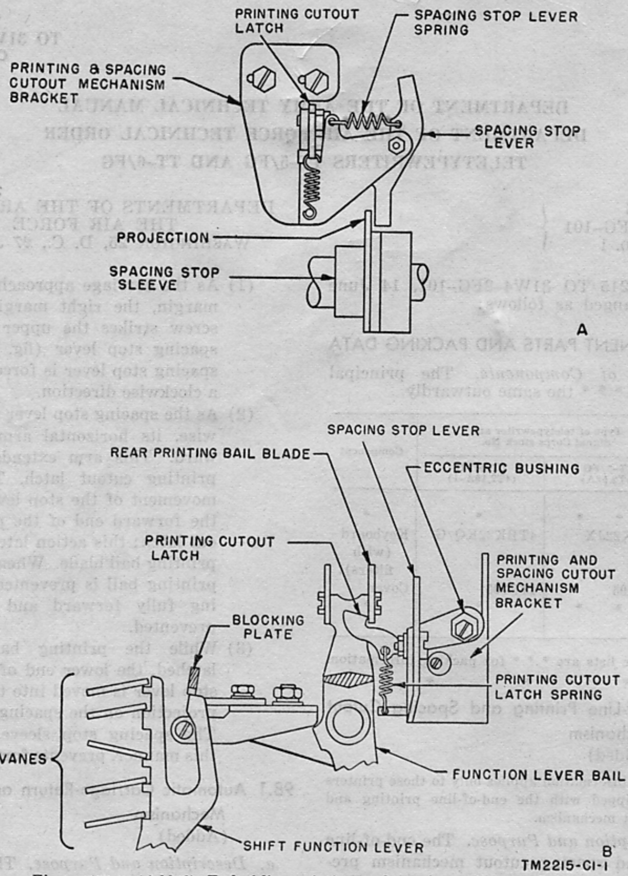


Figure 107.1. (Added) *End-of-line printing and spacing cutout mechanism.*

the trigger assembly. The trigger, with its extension, will move to the right. When this occurs, the automatic carriage-return and line-feed function lever is unblocked. This function lever then moves forward and operates a bail, the rearward extensions of which raise the carriage-return latch bar and the line-feed push bar (fig. 243.1 and 243.2), thus causing the carriage-return and line-feed mechanisms to operate.

108.1 Shift-Blank-Stop Mechanism (fig. 128.1) (Added)

Note. This information applies only to those printers that use a shift-blank-stop mechanism to print a symbol in the upper case H position.

a. Description and Purpose. The shift-blank-stop mechanism permits the printing of a letter or symbol when the platen is in the figures position and the H key is depressed. Without this

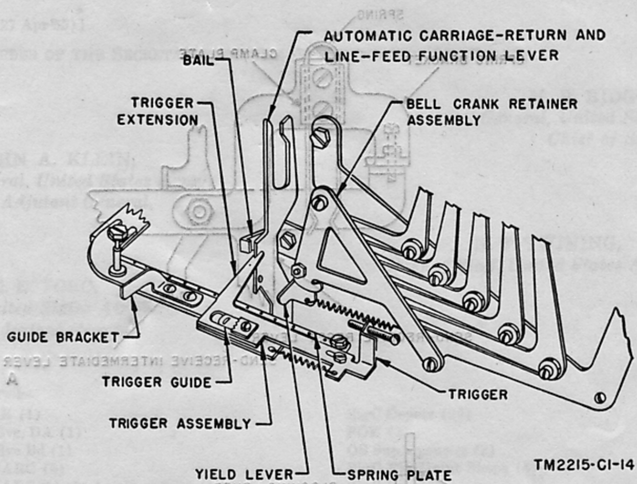


Figure 117.1. (Added) *Automatic carriage-return and line-feed assembly.*

mechanism, these actions will cause the motor to stop. This mechanism does not replace the motor-stop feature, but changes slightly the procedure for selecting the motor stop. To stop the motors it is necessary to transmit the figures, blank and H code combinations from the transmitter at any station. The shift-blank-stop mechanism consists of a spring bracket and a U-shaped spring (mounted on the send-receive reset lever) and a blocking lever (mounted on an adapter plate) that is fastened to the function lever spring plate. The position of the blocking lever is controlled by the position of the send-receive reset lever. The normal position of the send-receive reset lever, when code combinations other than blank are selected, is to the right. When the FIGS key is depressed, the platen moves to the figures position and the sixth vane is positioned to permit the motor-stop function lever to be selected (par. 101).

b. Operation.

(1) If the H key is depressed immediately following depression of the FIGS key, the motor does not stop because the blocking lever (fig. 128.1) prevents the motor-stop function lever from moving into engagement with the vanes. The printing bail is permitted to make a full forward movement, which causes the H type bar to print the upper case symbol.

(2) If the blank key is depressed immediately following depression of the FIGS key, the blank function lever is selected and the front extension causes the send-receive reset lever to move to the left (fig. 128). The U-shaped spring and spring bracket, mounted on the send-receive reset lever, move the front end of the blocking lever to the left also. The rear arm is moved out of the path of the motor-stop function lever. Under these conditions, depressing the H key causes selection of the motor-stop function lever, which is now free to move into the vanes; this action stops the motor (par. 108).

226. Ribbon-Reverse Shaft Links
(fig. 201)

* * * * *

b. Requirements. The ribbon-reverse bail should clear both the left and the right ribbon-

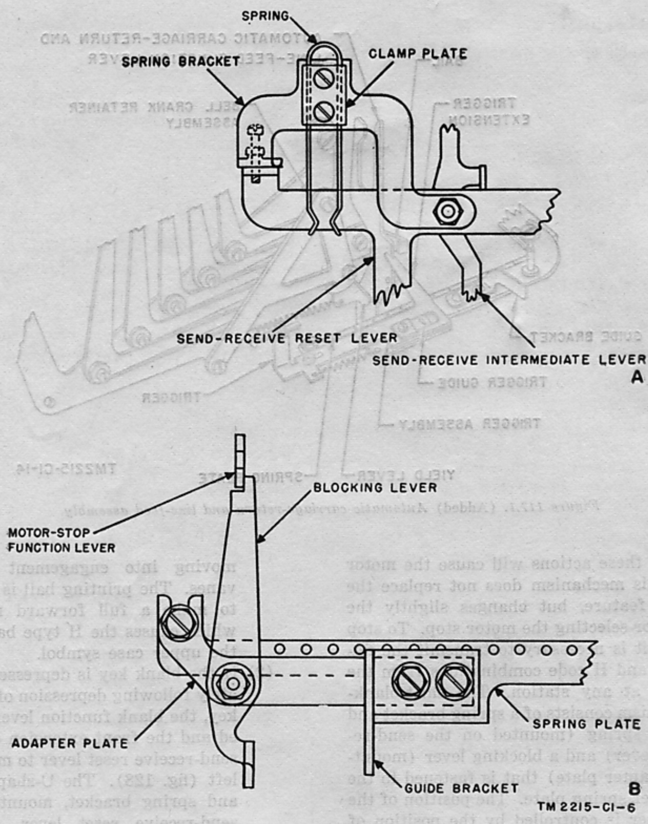


Figure 128.1. (Added) *Shift-blank-stop mechanism.*

reverse pawls by **.015- to .050-inch** when the pull-bar bail is in its extreme rear position, and both the left and the right ribbon-reverse arms are held forward against their stops. When checking * * * clearance a minimum. When checking for the **.050-inch** clearance, take up the play in a direction that will make the clearance a maximum.

* * * * *

Figure 201. "0.015″ to 0.040″" is changed to read: .015″ to .050″.

Figure 204. "1¼ to 5 lbs." is changed to read: 1¼ to 6 lbs.

237. Adjustable Ribbon Lock-Out Bar Detent Spring
(fig. 204)

* * * * *

b. Requirements. With the ribbon lock-out bar in its unoperated position (extreme right), and with the push end of a 12-pound scale bearing against the ribbon lock-out bar in a direc-

tion in line with the bar, it should require **1¼ to 6 pounds** to disengage the ribbon lock-out bar detent spring from its notch in the lock-out bar.

* * * * *

242. Carriage Support and Pull-Bar Bail Plunger Rollers
(fig. 102)

* * * * *

b. Requirements. The three carriage support rollers and the pull-bar bail plunger roller should turn freely **with a barely perceptible amount of end play.**

* * * * *

246. Main-Shaft Clutch Throw-Out Lever
(fig. 210)
(Superseded)

a. Preparation. Place the typing unit on the base and start the motor. Open the signal line. Close the signal line and then stop the motor.

b. Requirements. There should be from .010- to .020-inch clearance between the teeth of the two clutch members and the clutch throw-out lever should be free on its pilot screws with not more than .002-inch end play.

c. Adjustment. Position the clutch throw-out lever by its pilot screws.

250. Printing-Bail Shaft, Right Bearing
(fig. 213)

* * * * *

b. (Superseded) *Requirements.* With the printing bail held toward the right, there should be not more than .015-inch clearance between the end of the printing bail and the left bearing of the printing bail shaft.

* * * * *

255. Sixth Vane
(fig. 216)

a. Preparation. Remove the typing unit from the base and the type-bar carriage from the typing unit. **Place the platen in the letters position.**

b. (Superseded) *Requirements.* When the forward edge of the sixth vane is held in its lowest position, there should be a clearance of .008 to .030 inch between the right edge of the sixth vane extension and the right end of the slot in the letters push bar. When holding the vane in position, use only enough pressure to keep it in position without bending any of the parts involved. The vane should have some end play, but not more than .004 inch.

* * * * *

266. Armature Stops
(fig. 224)

* * * * *

b. Requirements. The right and * * * locking lever spring.

Note. (Added) The upper limit may be increased to .042 inch, only when necessary to meet the requirements in paragraph 282*b*.

* * * * *

Figure 228. Wherever it appears on the illustration, "0.006″" is changed to read: .010″.

278.1 Blocking Lever Adjustment
(figs. 228.1 and 228.2)
(Added)

Note. Adjustments in paragraphs 278.1 and 278.2 apply only to those printers equipped with the shift-blank-stop mechanism.

a. Preparation. Remove the typing unit from the base (par. 166).

b. Requirements.

(1) Set up the space combination on the vanes and rotate the main shaft until the function levers rest against the vanes. The blocking surface of blocking lever 88966 should clear the front edge of the motor-stop function lever by not more than .002 inch (fig. 228.1). The shoulder to the right of the blocking surface of the blocking lever should be in contact with the right side of the motor-stop function lever.

(2) Set the typing unit in figures shift position. Set up the H combination on the vanes. Rotate the main shaft until the motor-stop function lever is blocked by blocking lever 88966. Under these conditions, the motor-stop function lever should not block the downward travel of the function lever bail.

c. Adjustment. Loosen the screws mounting the adapter plate (fig. 228.1). Adjust the adapter plate by moving the left end in or out to meet the requirement. Tighten the mounting screws. If the printer is equipped with the auto-

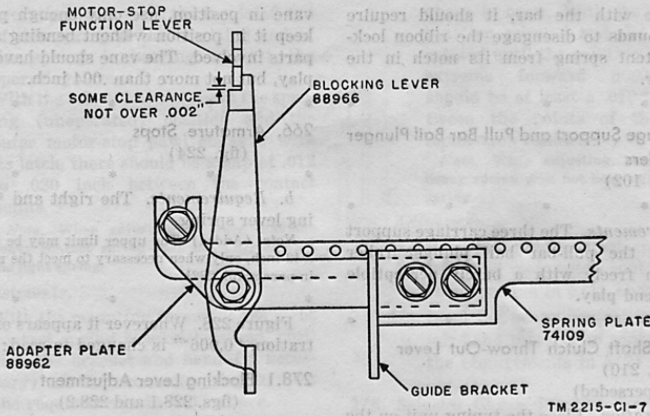


Figure 228.1. (Added) *Motor-stop blocking lever (top view).*

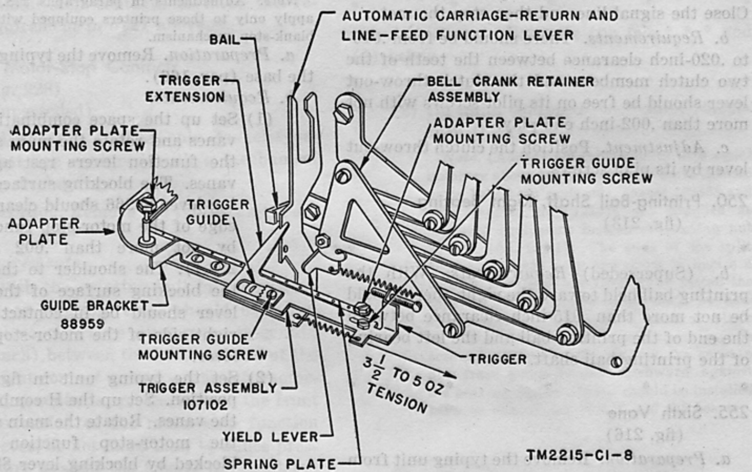


Figure 228.2. (Added) *Automatic carriage-return and line-feed assembly.*

matic carriage-return and line-feed mechanism, (fig. 228.2), the blocking lever is mounted on a post attached to a larger adapter plate, which is adjusted in the same manner to meet the requirements in *b* above. After making this adjustment on printers equipped with the automatic carriage-return and line-feed mechanism, recheck the trigger guide adjustment (par. 337.4).

278.2 Blocking Lever Spring Adjustment

(fig. 228.3)

(Added)

a. Preparation. Remove the typing unit from the base (par. 166).

b. Requirements.

(1) The humps of spring 88969 should travel an equal amount above and below the center of the forward end of blocking lever 88966 when send-receive reset lever 74407 is moved from the send to the receive position.

(2) There should be a clearance of not more than .004 inch between the left-hand arm of the spring 88969 and the forward extension of the blocking lever 88966 under the following conditions.

(*a*) The send-receive mechanism in the send position.

(*b*) The blank combination set up on the vanes.

(*c*) The main shaft rotated until the blank function lever rests against the vanes.

(*d*) Send-receive intermediate lever 74416 moved away from the blank function lever.

(*e*) The T-lever rotated clockwise until it touches the blank function lever.

(*f*) The extension of blocking lever 88966 resting against the line-feed function lever.

(3) There should be a clearance of not more than .004 inch between the right-hand arm of spring 88969 and the forward extension of blocking lever 88966 under the following conditions:

(*a*) The printing bail in its extreme rear position.

(*b*) The T-lever rotated clockwise.

(*c*) The send-receive mechanism in the send position.

(*d*) The T combination set up on the vanes.

(*e*) The main shaft rotated until the printing bail is in its extreme forward position.

(*f*) The blocking edge of blocking lever 88966 in front of the motor-stop function lever.

(*g*) The extension of blocking lever 88966 resting against the side of the motor-stop function lever.

c. Adjustment.

(1) Loosen clamping plate 88967 and adjust the height of spring 88969 to meet requirement in *b* (1) above.

(2) Bend the left-hand arm of spring 88969 to meet the requirement in *b* (2) above.

(3) Bend the right-hand arm of spring 88969 to meet the requirement in *b* (3) above.

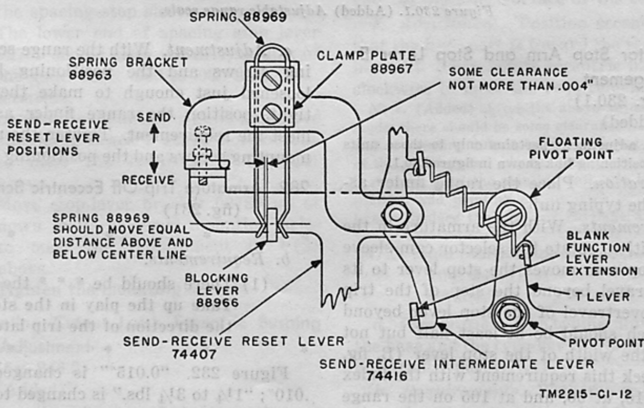


Figure 228.3. (Added) *Blocking lever spring assembly.*

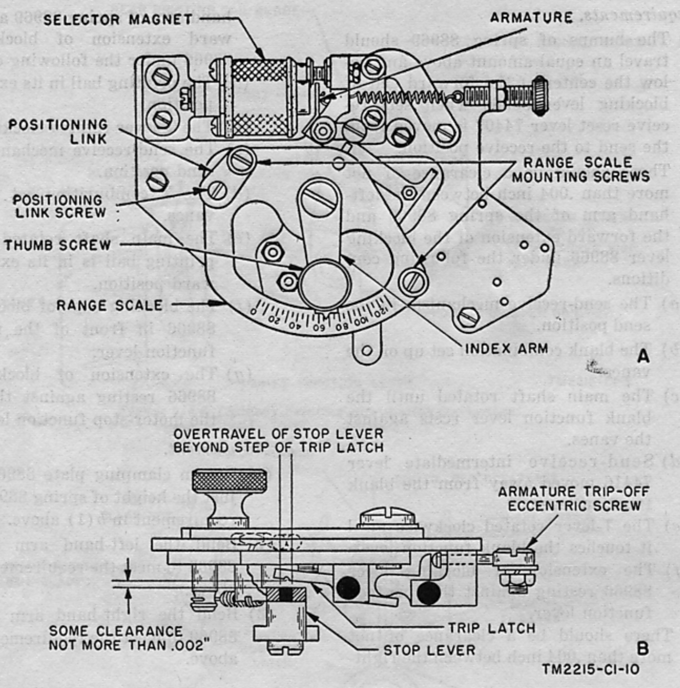


Figure 230.1. (Added) *Adjustable range scale.*

280.1 Selector Stop Arm and Stop Lever Engagement (fig. 230.1) (Added)

Note. This adjustment pertains only to those units that contain positioning link shown in figure 230.1.

a. Preparation. Place the range finder assembly on the typing unit.

b. Requirements. With the armature in the spacing position, rotate the selector cam sleeve until the stop arm moves the stop lever to its maximum travel beyond the step of the trip latch The overtravel of the stop lever beyond the trip latch should be at least half but not more than the width of the stop lever (B, fig. 230.1). Check this requirement with the index arm set at 15, at 60, and at 105 on the range scale.

c. Adjustment. With the range scale mounting screws and the positioning link screw loosened just enough to make them friction tight, position the range finder assembly to meet the requirement. Tighten the range scale mounting screws and the positioning link screw.

282. Armature Trip-Off Eccentric Screw (fig. 231)

*   *   *   *   *

b. Requirements.

(1) There should be * * * the trip latch. **Take up the play in the stop lever in the direction of the trip latch.**

*   *   *   *   *

Figure 232. "0.015"" is changed to read: .010"; "1¼ to 3¼ lbs." is changed to read: 1¼ to 4 lbs.

306. Line-Feed Link Turnbuckle
(fig. 232)

* * * * *

b. Requirements. With the single-double * * * the function-bail blade. Under this condition, the platen should rotate one line space, the detent roller should rest in the hollow between two ratchet teeth, and there should be some clearance, not more than **.010-inch,** between the line-feed pawl and the front face of a tooth on the ratchet. Check each tooth on the ratchet for this clearance.

Note. (Added) Do not take up the play in the line-feed mechanism when checking or making this adjustment. To check for *some clearance,* engage the line-feed pawl with a spring hook close to the spring post and lift the line-feed pawl just above the top, or point, of the tooth. Release the line-feed pawl from the spring hook. If the pawl returns fully to the hollow of the teeth, then *some clearance* requirement should be considered satisfied.

c. (Superseded) *Adjustment.* Place the typing unit on its right side. With the line-feed turnbuckle locknuts loosened, adjust the length of the line-feed vertical link by its turnbuckle.

312. Line-Feed Check Lever
(figs. 232 and 236)

* * * * *

c. Adjustment. Loosen the line-feed check-lever setscrew and position the line-feed check lever. Before tightening the setscrew, make sure that the shaft has some end play, not more than **.008-inch.** When checking the * * * the maximum clearance.

315. Pressure Roller Release Cams
(fig. 238)

* * * * *

b. (Superseded) *Requirements.* With the pressure roller release shaft arm in the rear position, the camming surfaces should line up with the release levers. With all the travel of the front pressure rollers taken up manually in a downward direction (so that the rear pressure rollers are resting against the platen), there should be at least a .060-inch clearance between the front pressure rollers and the platen. With all the travel of the rear pressure rollers taken up manually in a downward direction (front pressure rollers resting against the platen), there should be at least a .060-inch clearance between the rear pressure rollers and the platen.

* * * * *

321. Paper Fingers Shaft Spring Tension
(B, fig. 239)

* * * * *

b. (Superseded) *Requirements.* It should require from 16 to 22 ounces to start the stop arm moving under the following conditions: apply a 32-ounce scale to the paper fingers shaft stop arm between the paper fingers shaft stop post and paper fingers shaft spring, as close as possible to the stop post, and pull in line with the spring.

* * * * *

Figure 239. "14 to 18 ozs." is changed to read: 16 to 22 ozs.

330. Signal Bell Latch-Bar Latch Shims
(A, fig. 242)

* * * * *

b. Requirements. With the platen in the LTRS position (down), set up the letter S **(letter J, if bell-on-J type typing unit is used)** combination; rotate the main shaft until the printing bail is in its extreme forward position. When the front * * * to 0.010 inch.

* * * * *

337.1 Operating Bail Line-Feed Extension Adjustment
(Added)

Note. Adjustments in paragraphs 337.1 through 337.8 apply only to those printers equipped with the automatic carriage-return and line-feed mechanism.

a. Preparation. Remove the typing unit from the base (par. 166). Rest it on its right side.

b. Requirements. With the trigger extension (fig. 228.2) held in its operated position (to the right), rotate the main shaft until the automatic carriage-return and line-feed function lever (fig. 243.1) just touches the top vane. There should be a clearance not more than .010 inch between the top of the line-feed push bar (fig. 243.2) and the bottom of the function bail blade.

c. Adjustment. Loosen the bail mounting screws (fig. 243.2). Position the bail assembly line-feed extension by its enlarged mounting holes. Reposition the function bail blade if necessary. Tighten the bail mounting screws.

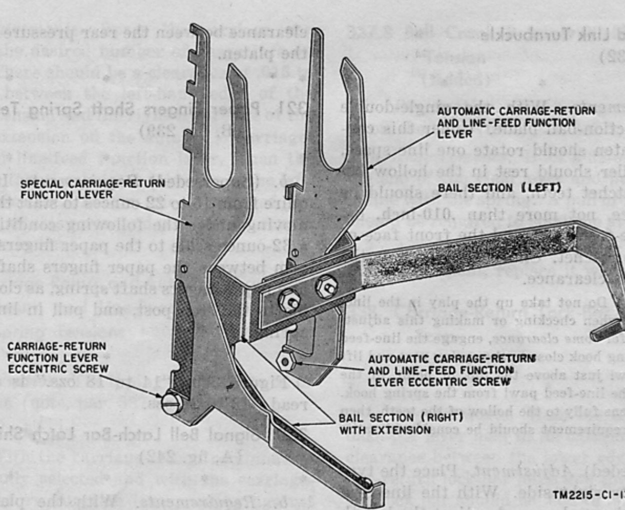


Figure 243.1. (Added) *Automatic carriage-return and line-feed bail assembly.*

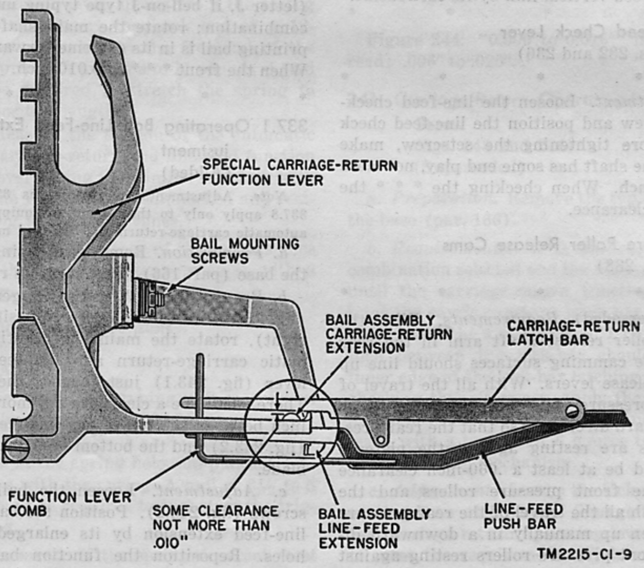


Figure 243.2. (Added) *Carriage-return latch bar and bail assembly.*

d. Method of Checking. To check the function bail blade adjustment, set up the letter O combination when the printing bail is in its rearmost position; then rotate the main shaft until the printing bail is in its extreme forward position. There should be some clerance between the upper edge of the line-feed extension projection of the bail and the lower edge of the line-feed push bar.

337.2 Automatic Carriage-Return and Line-Feed Function Lever Eccentric Screw Adjustment

(fig. 243.1)
(Added)

a. Preparation. Remove the typing unit from the base and rest it on the right side (note, par. 337.1).

b. Requirements. There should be the same clearance (within .010 inch) between the bottom edge of the carriage-return latch bar and the carriage-return latch-bar latch when either the special carriage-return function lever is selected or the automatic carriage-return and line-feed function lever is selected.

c. Adjustment. Position the automatic carriage-return and line-feed function lever eccentric screw.

337.3 Adapter Plate Adjustment

(figs. 228.1 and 228.2)
(Added)

Note. If the shift-blank-stop motor control mechanism is not used on the typing unit on which the automatic carriage-return and line-feed mechanism is installed, ignore references to the blocking lever in the following instructions.

a. Preparation. Remove the typing unit from the base (par. 166 and note, par. 337.1).

b. Requirements.

(1) The adapter plate should be approximately parallel to the spring plate (fig. 228.2).

(2) There should be a clearance not more than .002 inch between the front edge of the motor-stop function lever and the blocking end of blocking lever 88966 (fig. 228.1) when the space combination is selected and the main shaft is rotated until the function lever rests against the vanes.

(3) With the typing unit in figures shift position, the H combination selected, and the motor-stop function lever blocked by its blocking lever, the motor-stop function lever should not block downward travel of the function lever bail.

c. Adjustment. Loosen the two adapter plate mounting screws (fig. 228.2). With the trigger guide positioned in approximately the middle of its adjustable range (adjust, if necessary), adjust the adapter plate to meet the above requirements Tighten the adapter plate mounting screws.

337.4 Trigger Guide Adjustment

(figs. 228.2 and 228.3)
(Added)

a. Preparation. Remove the typing unit from the base (par. 166 and note, par. 337.1).

b. Requirements. With the letter O combination selected and the main shaft rotated until the printing bail is in the extreme forward position, there should be a clearance of not more than .010 inch between the carriage-return latch bar and the lobe on the carriage-return extension of the bail assembly.

c. Adjustment. Loosen the trigger guide mounting screws. Position the trigger guide by its elongated mounting holes. Tighten the trigger guide mounting screws.

d. Method of Checking. With the main shaft rotated until the printing bail is in the rear position, there should be at least a .005-inch clearance between the blocking edge of the trigger extension and the front edge of the automatic carriage-return and line-feed function lever, when the play is taken up to make this clearance a minimum.

337.5 Trigger Adjustable Screw Adjustment

(fig. 228.2)
(Added)

The automatic carriage-return and line-feed mechanism is adjustable to permit operation on any character between the 72d and 76th characters of the line. The length of the printed line is normally determined by the requirements of the system in which the unit is used (note, par. 337.1).

a. Preparation. The typing unit may be on or off the base.

b. Requirements. Space the carriage one less than the desired number of characters on the line. There should be a clearance of .015 to .020 inch between the left-hand edge of the trigger extension and the right-hand edge of the blocking extension on the automatic carriage-return and line-feed function lever, when the play in the function lever is taken up to the left.

c. Adjustment. Loosen the locknut of the trigger adjustable screw and position the screw. Tighten the locknut.

337.6 Carriage-Return and Automatic Carriage-Return and Line-Feed Function Lever Spring Tensions
(Added)

a. Preparation. The typing unit may be on or off the base (note, par. 337.1).

b. Requirements.

(1) With the carriage-return combination fully selected and with the carriage-return function lever resting against the vanes, unhook the carriage-return function lever spring from the spring plate. Insert the hook end of a 12-pound scale into the free end of the spring. A pull of 9 to 11 pounds should be required to stretch the spring to position length.

(2) Measure the tension of the automatic carriage-return and line-feed function lever spring in a similar manner, with the function lever unblocked and resting against the vanes.

c. Adjustment. If either of the springs does not meet the requirements, replace it with a new spring.

337.7 Trigger Spring Tension
(fig. 228.2)
(Added)

a. Preparation. The typing unit may be on or off the base (note, par. 337.1).

b. Requirements. Hook an 8-ounce scale over the trigger at the spring hole and pull horizontally in line with the spring. A pull of 3½ to 5 ounces should be required to just start the trigger moving.

c. Adjustment. If the spring does not meet the requirement, replace it with a new spring.

337.8 Bell Crank Retainer Yield Lever Spring Tension
(Added)

a. Preparation. The typing unit may be on or off the base (note, par. 337.1).

b. Requirements. Hook a 32-ounce scale over the end of the yield lever and pull horizontally in line with the spring. A pull of 24 to 32 ounces should be required to start the arm moving.

c. Adjustment. If the spring does not meet the requirement, replace it with a new spring.

338. Carriage-Return Lock-Bar Latch Eccentric Screw
(fig. 244)

*　　*　　*　　*　　*

b. Requirements. With the front end of the dash-pot lever held in its extreme left position, clearance between the lower edge of the carriage-return lock-bar latch and the upper edge of the lock bar should be **.006 to .020** inch. When checking this * * * clearance a minimum.

*　　*　　*　　*　　*

Figure 244. "0.006 to 0.015"" is changed to read: .006" to .020".

341. Carriage-Return Operating-Lever Stop Screw
(figs. 243 and 244)
(Superseded)

a. Preparation. Remove the typing unit from the base (par. 166).

b. Requirements. With the carriage-return combination selected and the main shaft rotated until the carriage-return function lever just trips the carriage-return latch bar off its latch, there should be a clearance of from .002 to .020 inch between the lock-bar shoulder and the inner edge of the lock-bar latching lever. When checking this clearance, apply the hook end of an 8-ounce scale on the lock bar and hold it outward with a tension of 6 ounces to take up all the play in the mechanism.

c. Adjustment. Loosen the locknut on the operating-lever stop screw. Change the height of the carriage-return operating-lever stop screw to meet the requirement. Tighten the operating-lever to stop screw locknut.

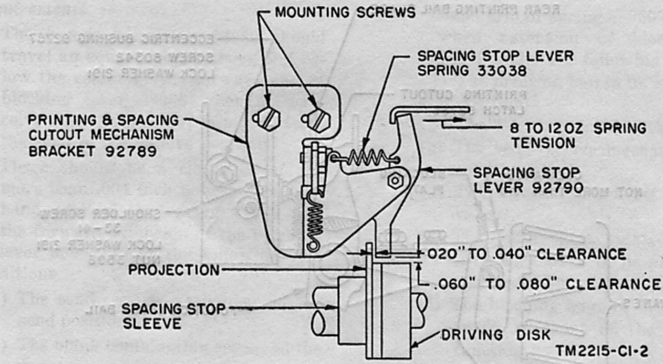


Figure 246.1. (Added) *Printing and spacing cutout mechanism bracket.*

347.1 Printing and Spacing Cutout Mechanism Bracket Adjustment

(fig. 246.1)
(Added)

Note. Adjustments in paragraphs 347.1 through 347.5 apply only to those printers equipped with an end-of-line printing and spacing cutout mechanism.

a. Preparation. Remove the typing unit from the base (par. 166).

b. Requirements.

(1) There should be a .020- to .040-inch clearance between spacing stop lever 92790 and the side of a projection on the spacing stop sleeve.

(2) The lower end of spacing stop lever 92790 should clear the driving disk of the main shaft .060 to .080 inch.

c. Adjustments.

(1) Loosen the mounting screws and move stop-lever bracket 92789 horizontally to meet the requirement in *b*(1) above.

(2) Move stop-lever bracket 92789 up or down in its enlarged mounting holes to meet the requirement in *b*(2) above.

(3) Tighten the mounting screws.

347.2 Printing Cutout Latch Eccentric Bushing Adjustment

(fig. 246.2)
(Added)

a. Preparation. Remove the typing unit from the base and remove the type-bar carriage (par. 166 and note, par. 347.1).

b. Requirements. Set up the figures combination on the vanes and rotate the main shaft until the function lever bail rests on the shift function lever. Push the printing bail toward the rear of the typing unit manually and raise printing cutout latch 92785 to engage with the rear blade of the printing bail. With the printing bail held by the latch, there should be a clearance of not more than .015 inch between the blocking arm of the shift function lever and the blocking surface of the blocking plate.

c. Adjustment. Position eccentric 92787 so that the high part is toward the rear of the typing unit. Then rotate eccentric 92787 counterclockwise to meet the requirement.

Note. (Added) After the above adjustment has been made, there should be some clearance between the front end of printing cutout latch 92785 and the front blade of the printing bail (A, fig. 246.3), when the main shaft is rotated, until the printing bail is in its extreme rear position and printing cutout latch 92785 is raised by hand. Replace the type-bar carriage and typing unit.

347.3 Right Margin Adjusting Screw Adjustment

(fig. 246.3)
(Added)

a. Preparation. The typing unit should be on the base and the type-bar carriage on the typing unit (note, par. 347.1).

b. Requirements. With the printing bail in the extreme rear position and the type-bar car-

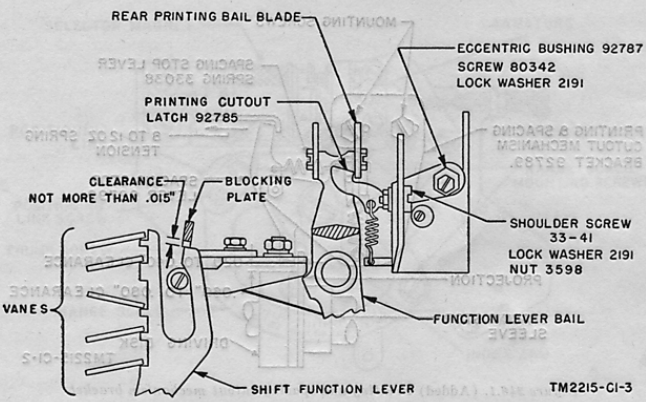


Figure 246.2. (Added) *Printing cutout latch mechanism.*

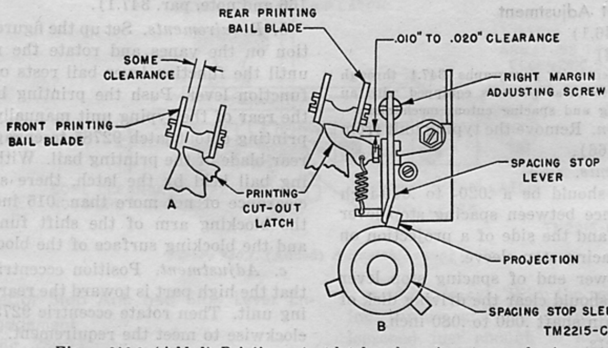


Figure 246.3. (Added) *Printing cutout latch and spacing stop mechanism.*

riage one space to the right of that in which the last character is to be printed, push the spacing stop sleeve projection backward just enough to permit spacing stop lever 92790 to pass in front of the projection. There should then be .010- to .020-inch clearance between printing cutout latch 92785 and the lower edge of the rear printing bail blade.

c. Adjustment. Loosen the right margin adjusting screw locknut. Position the right margin adjusting screw to meet the requirement. Tighten the right margin adjusting screw locknut.

347.4 Printing Cutout Latch Downstop Eccentric Adjustment

(fig. 246.4)

(Added)

a. Preparation. The typing unit may be on or off the base (note, par. 347.1).

b. Requirements. With the printing bail in its extreme forward position, there should be .008- to .015-inch clearance between the lower edge of the rear printing bail blade and the printing cutout latch.

c. Adjustment. Position eccentric 76277 so that the high part is toward the rear of the typ-

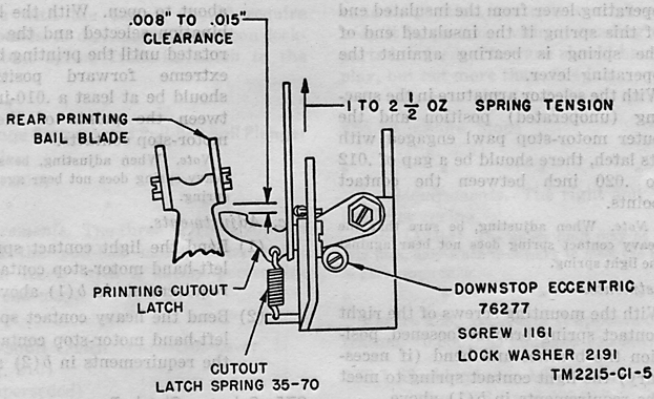


Figure 246.4 (Added) *Printing cutout latch downstop eccentric.*

ing unit. Then rotate eccentric 76277 counterclockwise to meet the requirement.

347.5 Printing Cutout Latch Spring Tension
(fig. 246.4)
(Added)

a. Preparation. The typing unit may be on or off the base (note, par. 347.1).

b. Requirements. With the printing bail in its extreme forward position, hook an 8-ounce scale under the printing cutout latch, just to the rear of the spring hole, and pull upward as nearly vertical as possible. A pull of 1 to 2½ ounces should be required to start the latch moving if properly adjusted.

c. Adjustment. If the printing cutout latch spring 35–70 fails to meet the requirement, replace it with a new spring.

351. Spacing Rack
(fig. 248)

* * * * *

c. (Superseded) *Adjustments.* Remove the type-bar carriage draw strap and loosen the spacing rack mounting screws. Position the rack toward the front or rear to meet requirements with the carriage, first in its extreme left, then in its extreme right, and finally in its center position. Retighten the screws and replace the draw strap.

361. Right Motor-Stop Contacts
(figs. 227 and 228)
(Superseded)

This adjustment applies only to teletypewriters equipped with a mechanical motor-stop mechanism.

a. Preparation. Remove the typing unit from the base.

b. Requirements.

(1) With the printing bail in the extreme rear position, hold the selector armature in the marking (operated) position and engage the inner motor-stop pawl with its latch. The contact spring mounting surface of the right contact spring bracket should be parallel to the top edge of the send-receive mechanism plate (gage by eye). There should be either a clearance of not more than .010 inch between the insulated end of the light contact spring of the right motor-stop contacts and the upper end of the contact operating lever, or a pressure of not more than ½-ounce against the upper end of the contact

operating lever from the insulated end of this spring if the insulated end of the spring is bearing against the operating lever.

(2) With the selector armature in the spacing (unoperated) position and the outer motor-stop pawl engaged with its latch, there should be a gap of .012 to .020 inch between the contact points.

Note. When adjusting, be sure that the heavy contact spring does not bear against the light spring.

c. *Adjustments.*

(1) With the mounting screws of the right contact spring bracket loosened, position the bracket and bend (if necessary) the light contact spring to meet the requirements in *b*(1) above.

(2) Bend the heavy spring of the right motor-stop contacts to meet the requirement in *b*(2) above.

362. Left Motor-Stop Contacts
(fig. 228)
(Superseded)

This adjustment applies only to teletypewriters that are equipped with a mechanical motor-stop mechanism.

a. *Preparation.* Remove the typing unit from the base.

b. *Requirements.*

(1) With the printing bail in its extreme rear position, there should be either some clearance (not more than .010 inch) between the insulated end of the light contact spring of the left motor-stop contacts and the lobe on the front extension of the motor-stop function lever, or not more than ½-ounce pressure against the lobe if the insulated end of the light contact spring is bearing against it.

(2) With the motor-stop function lever selected and the main shaft rotated until the right-hand motor-stop contacts are just at the point of opening, the left-hand motor-stop contacts should just close as the right-hand contacts are about to open. With the letters combination selected and the main shaft rotated until the printing bail is in its extreme forward position, there should be at least a .010-inch gap between the points of the left-hand motor-stop contacts.

Note. When adjusting, be sure that the heavy spring does not bear against the light spring.

c. *Adjustments.*

(1) Bend the light contact spring of the left-hand motor-stop contacts to meet requirements in *b*(1) above.

(2) Bend the heavy contact spring of the left-hand motor-stop contacts to meet the requirements in *b*(2) above.

375. Selector Clutch Torque
(fig. 257)

*   *   *   *   *

c. *Adjustment.* Saturate the felt * * * and (2) below.

*   *   *   *   *

(2) On units equipped * * * shim (0.020-inch thick)

Note. (Added) On typing units with serial numbers above 145751 (or older units if these parts have been replaced), spacer 122838 and split capstan nut 122974 are supplied as standard equipment instead of capstan nut 119541 (fig. 258.1). The ends of the split capstan nut are open and offset to insure a tight fit on keyed nut 119540. To install the capstan nut, the offset ends must be held approximately in line by a pair of pliers or a clamp. The slotted nut then may be screwed into place. To prevent the capstan nut from being turned downward against the bearing, spacer 122838 should be installed between slotted nut 119540 and the bearing.

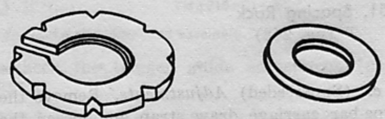


Figure 258.1. (Added) *Selector clutch capstan nut and spacer.*

[AG 413.48 27 Apr 55)]

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11–597A, Sig Base Depot Co (2)

NG: State AG (6); Unit: Same as Active Army except allowance is one copy to each unit.

USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

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